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**TRANSPORT CANADA
CIVIL AVIATION
UNMANNED AIR VEHICLE WORKING GROUP**

FINAL REPORT

September 2007

EXECUTIVE SUMMARY

This document represents the Final Report of the Unmanned Air Vehicle (UAV) Working Group, established to develop a regulatory framework for the operation of unmanned air vehicles with respect to terms and definitions, aircraft registration and marking, flight crew and maintainer licensing, maintenance, airworthiness and continuing airworthiness, operational flight rules and operational approval. The Unmanned Air Vehicle Working Group was a joint government and industry initiative, convened by Transport Canada, General Aviation in December 2006 to address the increasing volume and complexity of applications for unmanned air vehicle Special Flight Operations Certificates (SFOCs).

Background

The expanding service demands for UAVs include wireless communication, weather predictions, atmospheric research, geo survey, disaster intervention and assessment, protection of oil industry infrastructure assets, border security, cargo transport and others. UAVs have unique attributes, including persistence, versatility and compactness which make them (potentially) commercially attractive. A regulatory framework is required to ensure public safety and enable development of the UAV sector.

Terms of Reference

The Terms of Reference states, “the primary goal of the Working Group is to define a performance-based regulatory framework for medium to long-range, medium altitude, beyond line-of-sight UAV operations in Canadian airspace”. However, Working Group members realized early on that the basis of future UAV operations would not be general aviation sized aircraft, but rather small lightweight UAVs operated at low to medium altitudes and beyond visual range. At present, there are a very limited number of UAV models that are capable of flying in Class A and/or B airspace, and they are very expensive. In the U.S., for example, UAVs that fly at low altitude and weigh less than 10 Kg are expected to make up approximately 80% of civil production. Medium and high altitude aircraft may make up only 5 - 6% of all civil unmanned aircraft production. The Working Group recommendations capture “medium to long-range, medium altitude, beyond line-of-sight operations”, but the bulk of recommendations are more comprehensive in nature to address the emerging market. A summary of the scope is found at Section 5.0.

Recommendations

The majority of the Working Group recommendations are focused on the domestic use of UAVs. However in accordance with the Terms of Reference, current policies and requirements of foreign regulatory bodies and other agencies, particularly the U.S. Federal Aviation Administration (FAA), were taken into account. The Working Group strived to avoid the creation of dedicated UAV regulations as much as possible, since the goal is for UAVs to be integrated with, not segregated from, other airspace users. Recommendations have considered safety as the highest priority. A summary of key recommendations is found in Table 11-1.

UAV Classification

UAVs are extremely diverse with respect to airframe types, weight, size, speed, propulsion systems, payload carrying capabilities, mission profiles, degree of automation and data acquisition capabilities. The Working Group adopted classification based upon maximum take-off weight (MTOW) and type of operation (i.e., within or beyond visual range), with two reference weights that merited particular consideration: 35 Kg (in the *Canadian Aviation Regulations*), and 150 Kg (in European Aviation Safety Agency and North Atlantic Treaty Organization documents). Additional classification criterion that was considered is found in Appendix C.

Aircraft Registration and Marking

The Working Group recommends that all UAVs be marked and registered, and it is recommended that steps be taken by Transport Canada to begin issuing Certificates of Registration as soon as practical (i.e., by June 2008).

Associated work will include developing advisory material, amending applications for registration, modifying computer databases and assigning a series of marks.

Pilot/System Operator Training, Competencies and Licensing

Unmanned Aircraft System (UAS) pilots must be properly trained and regulated to assure safe integration within national airspace. All UAS pilots should be licensed by Transport Canada. Pilots wishing to conduct UAV operations, other than those associated with holding an Unmanned Aircraft System Pilot Permit, will be required to obtain a traditional (i.e., “manned”) Private or Commercial pilot licence with UAV type ratings endorsed on the licence. Unmanned aircraft system pilots will have to deal with wide variations in unmanned air vehicle performance capabilities and applications. The approach to training UAS pilots however, should not differ significantly from that currently applied to manned aircraft. Proposed Pilot Permits range from a permit for “Unmanned Aircraft System - Restricted to Visual Range” for UAVs below 35 Kg MTOW to a *Canadian Aviation Regulations* (CARs) Part IV Commercial Pilot Licence with UAV endorsements. These are summarized in Table 16-6.

Maintainer Competencies and Licensing

Unmanned aircraft system maintainers should be licensed by Transport Canada, unless the UAV has a MTOW weight below 35 Kg, and the UAV is operated within visual range, wherein the system maintenance including fitness of flight of the air vehicle could be the responsibility of the UAV owner/operator and an Aircraft Maintenance Engineer (AME) licence would not be required.

Airworthiness, Flight Authority and Maintenance Requirements

The unmanned aircraft system “aeronautical products” that would be subject to airworthiness requirements should include both the air and ground components of the system, such as engines, airframes, command and control links and sense and avoid systems. Multiple flight authorities may share common components (i.e., multiple aircraft controlled from one control station and/or multiple stations sharing control of a single aircraft). Flight Authority and Airworthiness issues are summarized in Tables 18.1 and 18.2. The Regulatory Framework for UAVs in all Weight Classes is summarized in Tables 19.1 through 19.4.

CARs Part VI

The Working Group conducted a review of the current regulations and standards that were written with unmanned air vehicles in mind (CARs Part VI, Subpart 3) as well as a review of CARs Part VI, Subparts 2, 5 and 6 to determine regulatory “gaps”. Details are found in Section 20. No recommendations are being made at this time to amend the Instrument Flight Rules.

The Working Group recommends that a new Subpart of the CARs be created, perhaps located in Part VI, to address operating certificates specific to unmanned aircraft systems. A new Working Group should be created to develop the operating certificate regulations and standards associated with private, commercial and state UAS operations. The decision to differentiate operating certificates assumes that the private certificate requirements would be less onerous (i.e., in the same way that there is a difference between CARs Part VI, Subpart 4 and Part VII, Subpart 5 operating certificates and requirements).

The regulatory system provided in the *Canadian Aviation Regulations* does not provide a complete set of safety requirements for unmanned air vehicles. Components of unmanned aircraft system operations that are not specifically addressed in regulations include: 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. A new Working Group should be created to address these UAV-specific components.

Roadmap

In conjunction with the Work Plan, Figure 12.2 identifies the current state of the UAV industry and charts a strategic plan to safely integrate unmanned air vehicles into the Canadian airspace system. It defines activities required by both Transport Canada and the UAV industry, including the key activities outlined in the following paragraphs:

- **Special Flight Operations Certificates** – The Working Group recognizes that the proposed regulatory amendments contained within this Final Report will take time for Transport Canada to implement. Until this goal of gaining safe and routine access to airspace is achieved, the short-term emphasis should be on ensuring that industry can safely conduct UAV operations using the SFOC procedures. The SFOC structure allows flexibility due, in part, to the lack of detailed standards. A lack of adequate resources within Transport Canada has, however, resulted in the inability to apply a standardized national approach in processing SFOC applications. This combination of factors has adversely affected UAV operators' ability to make business decisions and is negatively impacting the development of the UAV industry in Canada. The Working Group recommends that a new Working Group be created before the end of 2007 to review the existing UAV SFOC process with the goal of improving the process to better respond to the demands of the industry and to reduce Transport Canada's workload. Proposed membership includes: Transport Canada, Department of National Defence (DND), NAV CANADA and the UAV industry, including existing SFOC holders. The Working Group notes that participation of the Regional Transport Canada Civil Aviation Inspectors who are assigned responsibility for the safety oversight of unmanned air vehicles is essential to this effort.
- **Airworthiness Design Standards** – The Working Group recommends that one of the early tasks to be undertaken by the UAV Industry, in collaboration with Transport Canada, is the development or adoption of airworthiness design standards for unmanned aircraft systems with maximum take-off weights of the UAV not exceeding 150 Kg. For UAVs exceeding 150 Kg, it is recommended that Transport Canada participate in the development of internationally harmonized standards.
- **Collaboration between Government and the Private Sector in Canada** – The UAV sector provides considerable opportunities for economic growth and contributions to achieving strategic national objectives. Many countries are now attempting to organize and promote their unmanned vehicle sectors. Canadian industry is currently capable of becoming a world leader in unmanned aircraft system technology and services. The Working Group is unanimous in the view that the rapid development by Transport Canada of regulations and standards is critical to exploit this technological advantage for domestic and export opportunities. Transport Canada and Industry Associations will need to work closely in the logical development of enabling technologies. These technologies are a key ingredient to achieve the desired end state of the safe airspace integration of unmanned air vehicles. Other Canadian Government departments will follow Transport Canada leadership when Transport Canada states clearly that the development of enabling technologies is a key ingredient in an initiative to both grow an industry while meeting mandates for national safety and security.
- **Transport Canada Contribution** – With the increased demand for the utilization of national airspace, combined with the introduction of novel technologies, maintenance of current levels of safety will require the introduction of additional resources for both Transport Canada and the industry. The Working Group recommends the creation of a dedicated Transport Canada multi-disciplinary UAV team, under a program manager, to implement the recommendations of this report and to pool knowledge, experience and expertise.

This document provides Transport Canada with consensus-based considerations and recommendations for regulatory and policy development. Industry participation in this Working Group was substantial. The

associated investment by both Industry and Government was also substantial. To maintain the momentum that was generated by this activity, and to ensure continued support, the Working Group strongly recommends that the considerations and recommendations identified herein be actioned expeditiously. This includes forwarding the Final Report to the Civil Aviation Regulatory Committee (CARC) for review, as well as simultaneously creating a Working Group to review the UAV SFOC process. The Working Group members believe that if the recommendations proposed here are adopted, and the changes implemented, then Canada will have an effective regulatory system for safely integrating unmanned aircraft systems into Canadian domestic airspace.

LIST OF ACRONYMS

ADS-B	Automatic Dependent Surveillance- Broadcast
AFS-400	Flight Technologies and Procedures Division of the FAA Flight Standards Service
AME	Aircraft Maintenance Engineer
A-NPA	Advance – Notice of Proposed Amendment
ARC	Aviation Rulemaking Committee
ASTM	American Society for Testing and Materials
ATM	Air Traffic Management
AUVSI	Association for Unmanned Vehicle Systems International
CARAC	Canadian Aviation Regulation Advisory Council
CARC	Civil Aviation Regulatory Committee
CARs	Canadian Aviation Regulations
CCSVT	Centre Canadien des Systèmes de Véhicules Télépiloté
CCUVS	Canadian Centre for Unmanned Vehicle Systems
COA	Certificate of Authorization
COPA	Canadian Owners and Pilots Association
CS	Certification Specifications (EASA)
CTAISB	Canadian Transportation Accident Investigation and Safety Board
DND	Department of National Defence (Canada)
DOD	Department of Defense (United States)
DRDC	Defence Research and Development Canada
DUO	Designated UAV Operators
EASA	European Aviation Safety Agency
EU	European Union
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration
FINAS	Flight in Non-Segregated Airspace
FTE	Full-Time Equivalent
GOL	Government On-Line
HRSDC	Human Resources and Social Development Canada
IC2-DL	Interoperable Command and Control - Data Link
ICAO	International Civil Aviation Organization
ICAs	Instructions for Continued Airworthiness
IFR	Instrument Flight Rules
IRB	Industrial and Regional Benefits
JAA	Joint Aviation Authorities

JAR	Joint Aviation Requirements
JRCC	Joint Rescue Coordination Centre
MALE	Medium Altitude Long Endurance
MASPS	Minimum Aviation System Performance Specifications
MMIST	Mist Mobility Integrated System Technology
MoD	Ministry of Defence (France)
MOU	Memorandum of Understanding
MTOW	Maximum Take-off Weight
NATO	North Atlantic Treaty Organization
NPAs	Notices of Proposed Amendments
NRC	National Research Council
NRCAN	Natural Resources Canada
PSEPC	Public Safety and Emergency Preparedness Canada
RTCA	Radio Technical Commission for Aeronautics
SADI	Strategic Aerospace and Defence Initiative
SAE	Society of Automotive Engineers
SARPs	Standards and Recommended Practices
SFOC	Special Flight Operations Certificate
SMS	Safety Management Systems
STANAG	Standardization Agreement (NATO)
TCRG	Technical Community Representatives Group
TERPS	Terminal Instrument Procedures
TSB	Transportation Safety Board (Canada)
UAS	Unmanned Aircraft System
UASSG	Unmanned Aircraft Systems Study Group
UAV	Unmanned Air Vehicle
UCS	Unmanned Control System
UOC	Unmanned Aircraft System Operating Certificate
USAR	UAV Systems Airworthiness Requirements
UVS	Unmanned Vehicle Systems
VFR	Visual Flight Rules

1.0 BACKGROUND

Applications for unmanned air vehicle Special Flight Operations Certificates (SFOCs) are increasing annually and becoming increasingly diverse in terms of operational complexity, limitations and needs. The current approval processes and regulatory framework cannot effectively deal with this situation. An Unmanned Air Vehicle Working Group was convened by the General Aviation branch of Transport Canada in December 2006, to evaluate existing regulations and procedures, and to determine the scope of changes required to address the routine integration of unmanned air vehicles into a traditionally manned aircraft environment.

The initiative was designed to align the interest of stakeholders and define a logical sequence of work to generate the support of future policy and rulemaking decisions. It was the decision of Transport Canada senior management that this Working Group would not be a Working Group assigned by the Canadian Aviation Regulation Advisory Council (CARAC). However, recommendations by the Working Group to amend existing regulations, and develop new regulations, will be subject to full consultation through CARAC Technical Committees.

2.0 OBJECTIVE

The Terms of Reference states, “The primary goal of the Working Group is to define a performance-based regulatory framework for medium to long-range, medium altitude, beyond line-of-sight UAV operations in Canadian airspace. This framework is to be harmonized with the United States to the extent necessary to permit mutual recognition of the frameworks”.

3.0 EVOLUTION OF OBJECTIVE

When the Terms of Reference for the Working Group were drafted almost one year ago, the type of operation identified in the “Objective” was chosen as a logical starting point for two reasons. First, there was an impending proposed operation of a MALE (Medium Altitude Long Endurance) UAV in Canadian airspace (which was never realized) and second, this type of operation was seen as more complex than any previous applications that had been granted an operating certificate. While the description MALE comes from military UAV classifications, the intent was to focus on what is considered general aviation sized aircraft, operating beyond line-of-sight, which would be integrated into airspace with manned aircraft.

During the first meeting, Working Group members agreed that the anticipated future centre of UAV operations would, in fact, not be general aviation size aircraft. The centre of the civil market is anticipated to be small lightweight UAVs operated at low to medium altitudes beyond visual range. At present, there are a very limited number of UAV models that are capable of flying in Class A airspace and not many models are routinely operated in Class B airspace.

This realization was a contributing factor in Working Group discussions and decisions, and is expanded in Section 12.1.4. While the Working Group recommendations certainly capture “medium to long-range, medium altitude, beyond line-of-sight operations”, thereby meeting the Terms of Reference Objective, recommendations are more comprehensive in nature to address the real market that is now emerging.

4.0 HARMONIZATION

The Terms of Reference spelled out that the regulatory framework is to be harmonized with the United States framework to the extent necessary to permit mutual recognition of the frameworks. It should be emphasized that while the FAA expressed interest in participating in the Working Group, at the end of the day there was no participation by the FAA. In developing recommendations, the Working Group endeavoured to take into account current policies and requirements of foreign regulatory bodies and other agencies, as detailed in Section 12.1.7.

5.0 SCOPE

The Working Group's mandate was to examine the critical issues surrounding UAV operations, review existing legislation and make recommendations for a regulatory framework. The Working Group strived to avoid the creation of dedicated UAV regulations as much as possible, since the goal is for UAVs to be integrated with, not segregated from, other airspace users. Recommendations have considered safety as the highest priority. Both regulatory and non-regulatory approaches were considered during deliberations.

The majority of the Working Group recommendations are focused on the domestic use of UAVs since, at present, regulations have yet to be established by the International Civil Aviation Organization (ICAO) and other regulatory agencies. Ultimately the intent is to conform to ICAO standards and to have similar regulations governing UAV flights to allow transparent cross-border operations with the United States.

The Terms of Reference states, "Priority will be given to operational and airworthiness issues. Initial outputs will not, however, define specific airworthiness codes or equipment standards for the aircraft, the command, control and communication systems, or the ground control station. Additionally, the Working Group will not address:

- Sense and avoid systems or requirements;
- Spectrum management;
- Security matters (control links and control stations); or
- Special air traffic management considerations.

While it may be necessary to discuss these aspects of UAV operations during the meetings, these topics will not be pursued in detail at this time".

In addition to the above items, it should be emphasized that the following items were also not addressed/assessed in Working Group discussions, and therefore, were not taken into account when developing recommendations:

- UAVs operating inside buildings or underground;
- UAVs with passengers on board;
- Very large UAVs (e.g., transport category size);
- Micro UAVs (e.g., miniature dragonfly size);
- Establishing a minimum weight or size limit for applying regulations;
- Multiple UAVs controlled by one station;
- Disposable UAVs; and
- Approval for manufacturers of UAVs with a MTOW 150 Kg and below.

6.0 ASSUMPTIONS

The Working Group operated in the context of the following assumptions:

- 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 UAS 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;
- 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; and
- i) Subject to the SFOC risk assessment, appropriate sense and avoid techniques or equipment will be incorporated into unmanned aircraft systems to achieve collision avoidance commensurate with the class of airspace (and applicable flight rules) in which they will operate.

7.0 MEMBERSHIP

The Working Group membership roster (Appendix A) included representation from Transport Canada, DND, NAV CANADA, National Research Council (NRC), Canadian Owners and Pilots Association (COPA) and 16 private sector Canadian UAV stakeholders including UAS system developers, operators, UAV sector associations and academia.

8.0 MEETINGS

The Working Group held a teleconference on December 20, 2006 where the Terms of Reference were reviewed. From January – September 2007, seven meetings were held in Ottawa. Six meetings were of 3 days duration and the final meeting was of 2 days duration.

9.0 REPORTING

Meeting decision records were disseminated to Working Group members and to the Director, General Aviation. The Working Group presented an Interim Report to the Director, General Aviation on 30 March 2007. The Final Report was agreed to by the members of the Working Group at the September meeting. To keep the Final Report as brief as possible, many of the intermediate steps, debates and interim deliberations of the Working Group have been condensed.

10.0 DISSENTS

The Working Group Final Report is submitted without dissents.

11.0 RECOMMENDATIONS

It should be noted that the Working Group did not limit the recommendations to known technologies and applications. Section 12.4 to Section 23.2 constitutes the complete set of recommendations that the Working Group makes to the Director, General Aviation.

11.1 Key Recommendations

The following table serves as a summary of the key recommendations that are detailed throughout this Report.

Table 11-1 Key Recommendations

<i>Report Reference</i>	<i>Key Recommendations</i>
12.4	Prior to the UAV industry accepting the responsibility for administering some portion of the UAV regulatory infrastructure, the UAV Sector group should work with Transport Canada to develop the regulatory structure.
12.6	Transport Canada should increase resource allocations for UAV related work, including the creation of a dedicated multi-disciplinary UAV team, under a program manager, to implement the recommendations of this report and to pool knowledge, experience and expertise.
13.0	Three definitions currently contained in subsection 101.01(1) of the CARs should be amended and eight new terms and definitions, essential to understanding UAV operations, should be introduced in the CARs.
14.0	UAV classification should be based on MTOW (i.e., 35 Kg and 150 Kg) and type of operation (i.e., within or beyond visual range).
15.0 23.1	All UAVs should be marked and registered. Steps should be taken by Transport Canada to begin issuing Certificates of Registration as soon as practical (i.e., by June 2008), including the development of advisory material, amending applications for registration, modifying computer databases and assigning a series of marks.
16.0	Operators of launch systems, arresting hooks, observers, payload operators and mission planners should not require licensing certification.
16.0 16.3.2	All UAS pilots should be licensed by Transport Canada. "Made in Canada" licensing solutions should be available for pilots conducting specific operations with specific types of UAVs.
16.2.1	Minimum age requirements should be imposed for UAS pilots.
16.2.2	A Medical Certificate should be a prerequisite for every UAS Pilot Permit or Licence.
16.2.3	All UAS pilots should be required to pass a Transport Canada written examination.
16.2.4 16.4	All UAS pilots should require system-specific training. This training should be supplied by the operator, manufacturer or a third party.
16.2.5 16.3.4 16.4	All UAS pilots should have to demonstrate competency in the ability to perform normal and emergency procedures appropriate to the particular type of UAV. Flight tests/ skill tests/ proficiency checks leading to a type rating should be conducted by qualified UAV operators, manufacturers or third parties.
16.2.6	Currency and proficiency for UAS pilots should be maintained in accordance with section 401.05 of the CARs.
16.4	Specific operational training (i.e., requirements unique to the UAV operator) should be supplied to UAS flight crew by the UAV operator.
17.0	UAS maintainers should be licensed by Transport Canada, except where the UAV has a MTOW that does not exceed 35 Kg and the UAV is operated within visual range and under visual flight rules (VFR). In this case, the UAS maintenance could be performed by the UAV owner/operator and an AME licence should not be required.
17.1	A new UAS rating for AME Licence holders should be developed.
18.1	Flight authorities should be mandated for all UAVs, except where the UAV has a MTOW that does not exceed 35 Kg and the UAV is operated within visual range and under visual

Report Reference	Key Recommendations
	flight rules (VFR).
18.2	There should be Transport Canada airworthiness input into the SFOC approval process.
12.4.1 18.2	The UAV Industry, in collaboration with Transport Canada, should develop or adopt an airworthiness design standard for UAS where the MTOW of the UAV does not exceed 150 Kg. The concept for this design standard should be approved by Transport Canada before work commences.
18.2	UAVs with a MTOW exceeding 150 Kg should be type certified.
20.0	There should be amendments to CARs Part VI, Subparts 2, 3 and 5.
20.2	A new Subpart of the CARs should be created to address operating certificates specific to unmanned aircraft systems. A new Working Group should be created to develop the operating certificate regulations and standards associated with private, commercial and state UAS operations.
21.0	A new Working Group should be created to address UAS-specific components.
22.1	The <i>Canadian Transportation Accident Investigation and Safety Board (CTAISB) Act</i> should be reviewed to ensure that UAV accidents and incidents are appropriately tracked and documented.
22.2	In order to avoid unnecessary searches, UAV crashes should be reported when there is a possibility of the crash event or wreckage being confused with a manned aircraft.
22.3	Transport Canada should monitor the outputs from Standards groups as well as other bodies developing UAS standards, such as the North Atlantic Treaty Organization (NATO).
23.2	A new Working Group should be created before the end of 2007 to look at the existing UAV SFOC process with the goal of improving the process for the benefit of both Transport Canada and the UAV industry. Participation of Regional Inspectors assigned responsibility for the safety oversight of UAVs is essential.
Summary	Transport Canada should accept and implement the proposed 5 year Work Plan.

12.0 ROADMAP

UAVs are legitimate airspace users. This roadmap charts a strategic plan to safely integrate unmanned air vehicles into the Canadian airspace system. It identifies the current state of the UAV industry and charts a strategic plan towards the ultimate goal of safe airspace integration. It defines activities required by both Transport Canada and the UAV industry. Shortcomings will be identified and recommendations will be made how best to overcome these shortcomings to achieve the end state.

This Roadmap will assist Transport Canada decision makers in implementing UAV regulations, will identify the highest value areas for industry investment and will identify areas for national and international cooperation.

12.1 *Current Situation - 2007*

12.1.1 *Characterization of UAV Applications*

Market demands for efficient and productive alternatives to a myriad of services to support the health of the world are on the rise. These expanding services include wireless communication, weather predictions, atmospheric research, disaster intervention and assessment, protection of oil industry infrastructure assets, border security, cargo transport and others. While UAVs will not replace manned aircraft for all missions, they do provide unique capabilities in support of many of these services. Attributes that make UAVs effective platforms include persistence and versatility. Additionally, there is a great benefit to an aircraft system that does not endanger the pilot when operating close to hazardous areas or in hazardous environments. With miniaturization technology, there will likely be more uses for UAVs than there has ever been for manned aircraft.

While the Working Group characterized UAV operations into six general groups, this list is by no means complete.

Sensor/Surveillance:

- a) Inspections;
- b) Monitoring;
- c) Measurements;
- d) Targeting/tracking;
- e) Search and Rescue;
- f) Aerial photography/filming;
- g) Detection;
- h) Border patrol; and
- i) Research.

Payload delivery (non-reusable payloads):

- a) Fire-fighting;
- b) Crop dusting/spraying;
- c) Relief supplies/cargo;
- d) Dangerous goods (weapons);
- e) Piggyback aircraft; and
- f) Cloud seeding.

Orbiting:

- a) Communications relay;
- b) Banner towing;
- c) Radio broadcasting;
- d) Traffic, sporting events;
- e) Audio broadcast;
- f) TV broadcasting; and
- g) Advertising.

Transport:

- a) Goods/cargo;
- b) Persons (eventually); and
- c) Aircraft (piggyback).

Flight training:

- a) Pilots and payload operators.

Test flights:

- a) Testing of airframes, onboard systems, etc.

12.1.2 Current Transport Canada - Resources, Regulations and Oversight

Special Flight Operations Certificates are issued by Transport Canada Regional Offices. The General Aviation Inspectors who issue the Certificates are not “dedicated” to managing UAV operations. Their duties include personnel licensing, aircraft registration and leasing, rocket launch authorizations, personal aviation and issuing SFOCs for special aviation events. In Headquarters, the Office of Primary Interest for UAVs is staffed with one Inspector who has additional duties in personal and general aviation. This existing situation of less than a single full-time equivalent (FTE) in the Office of Primary Interest in Ottawa is inadequate to meet the needs of the community and to provide functional advice and support to Regional staff. In the Regions, as applications for SFOCs increase, service line standards are not being met.

The SFOC structure allows flexibility due, in part, to the lack of detailed standards, however this is not a sustainable process, particularly as the number of SFOC applications increases annually. A lack of adequate resources within Transport Canada has resulted in the inability to apply a standardized national approach in

processing SFOC applications. This combination of factors has adversely affected UAV operators' ability to make business decisions and is negatively impacting the development of the UAV industry in Canada.

The monitoring of UAV operations is addressed in the Transport Canada "Frequency of Inspection Policy Document" under Operational Task No. 22D089.

12.1.3 Overview of Current UAV Industry – Canada and Worldwide

Canadian industry is currently capable of becoming a world leader in unmanned aircraft system technology and services. The Working Group is unanimous in the opinion that the rapid development by Transport Canada of regulations and standards is critical to exploit this technological advantage for domestic and export opportunities.

There are more than 220 UAV-related firms in Canada. The sector is also supported by at least 38 post secondary researchers, research centres, or technical training institutes. There are also approximately 60 government organizations with an interest in UAVs.

It is projected that the worldwide UAV civil and military market will reach \$40 billion within 4 years. The strategic importance of the international UAV sector continues to grow. Advances in robotics, artificial intelligence and platform development have moved the sector into mainstream national defence applications as well as a host of practical civilian applications. It is believed that the most rapid growing civil applications will be science-related (e.g., meteorological), border surveillance, maritime surveillance, forest fire detection and emergency services.

12.1.4 MALE UAVs versus Apparent Market

A recent U.S. study indicates that aircraft that fly at low altitude and weigh less than 20 lbs are expected to make up approximately 80% of all civil unmanned aircraft produced. Larger, low altitude vehicles comprise approximately 15% of forecast civil production. These are expected to be a mix of small, long endurance vehicles and vertical take-off and landing aircraft. Medium and high altitude aircraft will make up only 5-6% of all civil unmanned aircraft production.

With military UAVs becoming more expensive, it is becoming less attractive to adapt military UAVs for civil use. It is unlikely that the civil commercial market is going to be saturated with MALEs, rather lower cost UAVs will serve the civil market.

Capability is continually being pushed down toward smaller platforms that are more affordable and more manageable. This is being enabled by the ongoing process of miniaturization of sensors, controls, data link solutions, and computing elements. Thus, both the UAV industry and Transport Canada are best served by focusing on the small-system area to improve the regulatory process and enabling access to airspace. Put another way, the maximum leverage of the effort that is going to be expended in establishing a regulatory framework will come about by addressing this area, both from the perspective of enabling flight in civil airspace, and from standardizing the approval process.

12.1.5 Canadian UAV Advocacy and Facilitating Organizations

In Canada, there are presently three UAV Sector Industry organizations with varying roles, including performing and/or facilitating activities such as:

- a) Promotion of the Canadian UAV Sector;
- b) Serve as a regulatory conduit for policy development;
- c) Collect market intelligence;
- d) Assistance and coordination in SFOC applications;
- e) Education and training;

- f) Liaison with insurance companies;
- g) Research and development;
- h) Test and evaluation; and
- i) Technology commercialization.

Unmanned Vehicle Systems Canada

Established in 2002, Unmanned Vehicle Systems Canada (UVS) Canada is an independent all-Canadian non-profit association that includes industry, academia, government and other interested persons in its membership. The association's objectives are to identify the UVS Canadian Community to itself, to other Canadians, and to the rest of the world; and to be the non-partisan organization representing the interests of all Canadians, from all Regions, Provinces and Territories, with respect to unmanned vehicle systems.

AUVSI - Canada

AUVSI-Canada is a national affiliate of the United States based Association for Unmanned Vehicle Systems International (AUVSI). It has been established by representatives from leading Canadian defence companies, Canadian provincial governments and academia to promote the advancement and global application of Canadian expertise in the growing field of unmanned vehicle systems. Its primary focus is to increase awareness of Canada's leading-edge research and capabilities in fielding state-of-the art technologies and systems in the rapidly growing area of unmanned vehicle systems.

Canadian Centre for Unmanned Vehicle Systems

The Canadian Centre for Unmanned Vehicle Systems (CCUVS) - Le Centre Canadien des Systèmes de Véhicules Télépilote (CCSVT) is a not for profit company governed by a national board of directors drawn from industry, government and academia. CCUVS provides unbiased, joint use facilities to meet Canada's test and evaluation, research and development, commercialization and training needs. It operates from offices in Medicine Hat, Alberta. The mission is to reach across Canada to promote and bring focus to research, development and commercialization of Unmanned Vehicle Systems (UVS) technology. The Centre unifies university, government and industry interests in aerial, marine and land UVS applications. The vision is the facilitation of sustained profitable growth in the Canadian UVS sector.

12.1.6 Standards Groups – United States and Europe

Radio Technical Commission for Aeronautics

Radio Technical Commission for Aeronautics (RTCA) Special Committee - 203 was formed in late 2004 and functions as a Federal Advisory Committee. Twenty international organizations are participating in the committee. The first deliverable was published in May 2007 - Guidance Material and Considerations for UAS. The next step is to initiate a baseline determination and data discovery process (tailored DO-264 process for coordinating requirements determination). Standards Working Groups are in place for:

- a) UAS Minimum Aviation System Performance Specifications (MASPS);
- b) Command, Control and Communications systems; and
- c) Detect, Sense and Avoid systems.

American Society for Testing and Materials International

In July 2003, American Society for Testing and Materials (ASTM) International Committee F-38 was created to develop standards and guidance materials for unmanned air vehicles. Work continues within the subcommittees dealing with airworthiness, flight operations and operator qualification issues. The standards that have been approved include:

- a) Design and Performance of an Airborne Sense and Avoid System;
- b) Standard Practice for Maintenance and Manuals for Light UAS;
- c) Standard Practices for UAS Airworthiness;
- d) Standard Practice for Design and Manufacture of Turbine Engines for UAS;
- e) Design and Performance of Pneumatic-Hydraulic Launch Systems; and
- f) Design and Manufacture of Compression Ignition Engines for UAS.

Work-in-progress items include:

- a) Commercial UAS Pilot Practical Test Standards;
- b) Standard Practice for UAS Visual Range Ops;
- c) Standard Guide for Mini-UAS Airworthiness;
- d) Standard Practice for Pilots Operating within Visual Range;
- e) Standard Classification for Unmanned Aircraft Pilot Certification; and
- f) Standard Specification for Design & Performance of Mini-UAS Recovery Systems.

Society of Automotive Engineers International

Society of Automotive Engineers (SAE) International is an international resource for standards development, events, and technical information and expertise used in designing, building, maintaining, and operating self-propelled vehicles for use on land or sea, in air or space. The current work-in-progress includes an aerospace recommended practice document (ARP5707) entitled, “Pilot Training Recommendations for Unmanned Aircraft Systems (UAS) Civil Operations”. It provides a guide to the knowledge, skills, and abilities necessary for pilots to conduct specific types of UAS operations and provides a template for appropriate operational training for UAS pilots and one means to evaluate that training for civil UAS operator applications.

European Organisation for Civil Aviation Equipment

The European Organisation for Civil Aviation Equipment (EUROCAE) Council has now approved the Terms of Reference for Working Group-73. The primary task is to develop a UAS requirements framework that would enable manned and unmanned aircraft to be managed in the same way within the existing Air Traffic Management (ATM) environment. If it is determined that some aspects of UAS normal and abnormal operations might require special ATM consideration, the issues concerned will be communicated to EUROCONTROL and ICAO.

A “Small UAS” Special Interest Group has now been formed within EUROCAE WG-73 and will operate under the EUROCAE mandate to determine a common European approach to the operation of small UAS (i.e., less than 150 Kg), since these UAS do not fall within the remit of the European Aviation Safety Agency (EASA). UAS under 150 Kg have significant capabilities and transnational operating ranges, so it is an issue of international interoperability.

12.1.7 Harmonization

FAA

UAS Program Plan

The 5-year UAS Program Plan, soon to be publicly available, details resources (presently 17 people associated with the UAS Program Office), evaluates the current state of UAS mission needs, forecasts

UAS near-term demands on airspace capacity, and charts a strategic plan to safely integrate UAS operations into U.S. airspace.

Certificate of Authorization

The operation of UAS in the national airspace system for government and public operations is approved on a case-by-case basis through the issuance of a Certificate of Authorization (COA). The COA is not available to commercial entities. Over 100 COAs were issued in 2006 and the projections for 2007 and beyond show a significant increase (i.e., 30 % annual increase). The FAA has created a web-based application system that provides applicants an electronic method of requesting a COA. Applicants need to obtain an account in order to access the online system.

Special Certificate of Airworthiness- Experimental

Commercial companies must obtain Special Certificates of Airworthiness - Experimental for their UAS. The latest certificates issued were to AAI Corporation for the Shadow 200B unmanned aircraft system and Raytheon Missiles Systems for three Cobra UAS. The certificates are good for one year from the date of issuance. To date, 12 Special Certificates of Airworthiness have been issued, with 4 more in the queue. They have been issued for unmanned air vehicles ranging from 4 lbs to 12,000 lbs. These aircraft are issued Certificates of Registration and are marked accordingly.

Aviation Rulemaking Committee on Small UAS

Approval has been granted to the UAS Program Office to stand up an Aviation Rulemaking Committee (ARC) on small UAS (under 35 lbs). The intent is to find a process that will allow small UAS to conduct commercial operations within visual range, day VFR and in unpopulated areas. It is anticipated that the work will take 8 to 12 months to complete.

UAS Technical Community Representatives Group

In July 2004, the FAA took the first step to establish a UAS Research Program by creating the Technical Community Representatives Group (TCRG) to identify research requirements that are needed to support FAA UAS regulatory and safety oversight activities. This year, the United States Congress officially established the FAA UAS Research Program by authorizing a separate budget line in the FAA Research, Engineering and Development appropriation. The technology issues that have been given high priority include sense and avoid technologies and UAS command, control and communication requirements.

Other Work-in-Progress

- a) The FAA has signed a Memorandum of Understanding (MOU Action Plan 24) with EUROCONTROL to work on UAS issues, such as frequency spectrum;
- b) Draft Order 8130.UAS (experimental airworthiness certification) is close to finalizing;
- c) AFS-400 Policy 05-01 has been revised and will soon be released on the UAS website; and
- d) The FAA is preparing a MOU with DOD that will allow for the operation of small (under 20 lbs) military UAS without the requirement to obtain a COA, subject to airspace restrictions and operating limitations.

ICAO

The Air Navigation commission of ICAO has agreed to the establishment of an Unmanned Aircraft Systems Study Group (UASSG) to address unmanned air vehicles in order to assist the Secretariat in developing a framework for a regulatory concept; guiding the Standards and Recommended Practices (SARPs) development process within ICAO, identifying communication requirements, and to support a safe, secure and efficient integration of UAVs into international airspace. The first meeting of this group will likely be held in early 2008.

EASA

EASA is expected to publish, by the fall of 2007, the generic policy for UAV type certification based on the Advance – Notice of Proposed Amendment (A-NPA) from 2005. In early June 2007, EASA issued their first Permit to Fly to the Schiebel CAMPCOPTER S-100 UAV System. This Permit to Fly will enable Schiebel to obtain national flight permissions within the European Union (EU) member states much more easily. The Permit to Fly was issued for test flights and for system demonstration flights for customers.

EUROCONTROL

In 2004, EUROCONTROL began work on ATM Specifications for the Use of Military Unmanned Aerial Vehicles as Operational Air Traffic Outside Segregated Airspace. This work is now complete, and EUROCONTROL has begun drafting ATM specifications for military UAVs inside segregated airspace. Individual states will be left to decide whether or not to incorporate the EUROCONTROL UAV Specifications into their own national regulations. Since EUROCONTROL is not relying on segregated airspace for UAV operations, they will be looking at all the air traffic management shortcomings and enhancements that may be required to integrate UAVs with manned aircraft operations.

NATO

In 2004 NATO created the UAV Flight in Non-Segregated Airspace (FINAS) Working Group. This working group was designed to facilitate the cross-border flight of NATO UAVs. Efforts of FINAS include the creation of various Standardization Agreements (STANAGs) to include; Designated UAV Operator training standards (undergoing ratification); Sense and Avoid functional requirements (preparing for ratification); and a System Security Requirements (in draft form).

Additionally, within FINAS the UAV Systems Airworthiness Requirements (USAR) Specialist Team was created and has now completed the NATO UAV airworthiness code based on the French MoD USAR vA (dated March 22, 2007). It is a tailored adaptation of the manned civil aviation airworthiness code CS-23 (JAR-23). The airworthiness code deals with fixed-wing UAVs with a MTOW 150 Kg - 20,000 Kg and is intended for use by NATO as a future STANAG 4671. It is anticipated that the STANAG will be ratified by the end of 2007. DND has sent an official Canadian response to NATO with input from the Working Group.

Additional UAV-related NATO STANAGs:

- a. STANAG 7085 - Interoperable data links for imaging systems;
- b. STANAG 4586 - Standard interface of the unmanned control system (UCS) for NATO UAV interoperability; and
- c. STANAG 4660 - IC2-DL (interoperable command and control data link).

12.2 Work Plan for Complete and Safe Integration into Canadian Airspace: 2012

The Working Group proposes the following Work Plan to achieve complete and safe integration of UAVs into Canadian airspace by the year 2012. The Working Group believes there is an immediate need for the creation of a UAV SFOC Review Working Group. All other Working Groups that are referenced in this Work Plan would be part of a longer-term process to achieve routine operations of UAVs in Canadian airspace.

WORK PLAN

2007:

- a) Submit Unmanned Air Vehicle Working Group Final Report to Transport Canada Senior management; and
- b) Approval and creation of a UAV SFOC Review Working Group.

2008:

- a) Implement registration of UAVs;
- b) Revise Staff Instructions in accordance with UAV SFOC Review Working Group recommendations and implement additional recommendations (advisory material etc.);
- c) Have procedures/exemption(s) in place for UAVs operating inside buildings and underground;
- d) Continue the development of Industry Groups to represent the Canadian UAV Industry to Transport Canada;
- e) Initiate collaborative effort toward Design Standards; and
- f) Allocation of dedicated Transport Canada resources.

2009:

- a) Develop or adopt Airworthiness Design Standards for UAVs with a MTOW not exceeding 150 Kg;
- b) Creation of a Working Group to deal with UAS-specific components; and
- c) Create Notices of Proposed Amendments (NPAs) for presentation at CARAC Technical Committee Meetings:
 - i. January 1st – December 30th:
 - 1. General Operating and Flight Rules;
 - 2. Pilot/Maintainer Qualifications and Training; and
 - 3. Maintenance and Flight Authorities.

2010:

- a) Create NPAs for presentation at CARAC Technical Committee Meetings:
 - i. Completed by December 30th:
 - 1. Airworthiness Certification;
 - 2. Operating Certificates (new Working Group); and
 - 3. New operating rules (e.g., IFR approaches etc.).
 - b) Development of Advisory material / Exemptions - after approval of NPAs

2012:

- a) Completion – safe airspace integration.

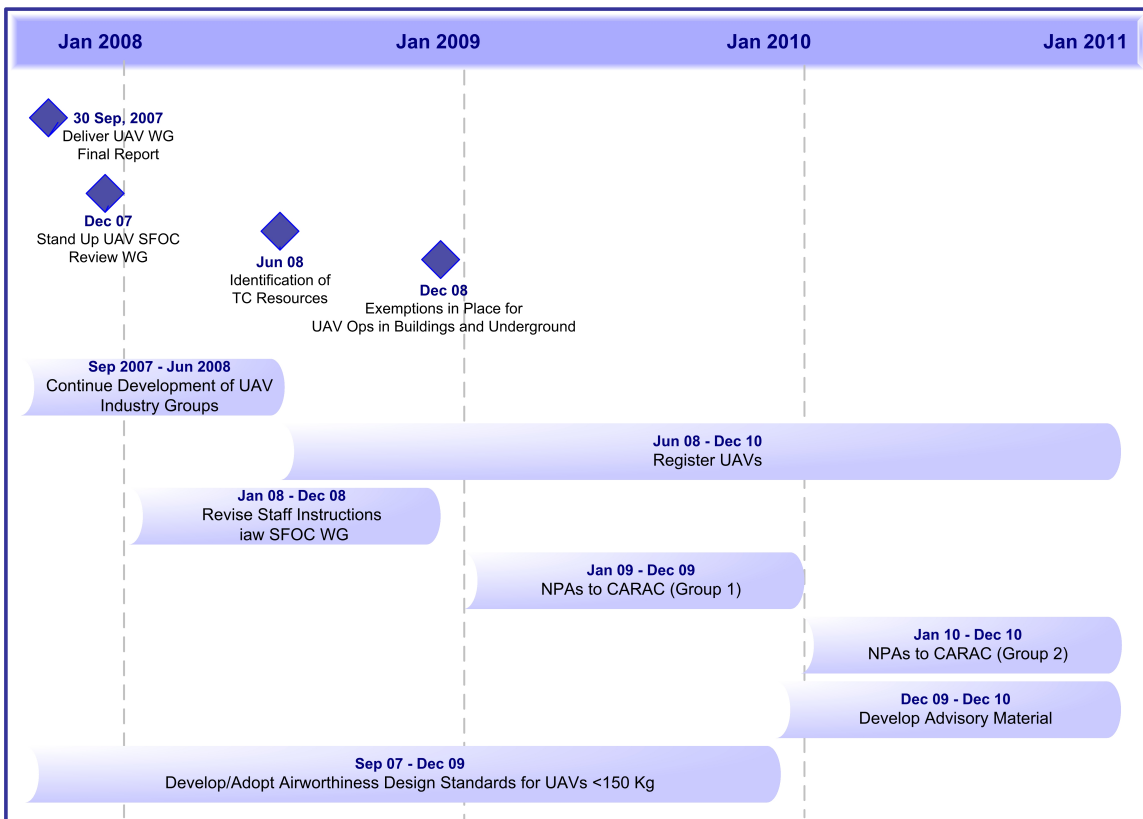


Figure 12-2 Work Plan

Notes:

- Harmonization requirements will be considered throughout these activities and will be incorporated as appropriate and applicable.
- Required new technologies, such as sense and avoid, are key issues that must be addressed to achieve the goal of safe, routine use of the airspace by UAVs. The target date is dependent on availability of the critical technologies.
- Change to existing airspace management / air navigation procedures – i.e., introduction of Automatic Dependent Surveillance- Broadcast (ADS-B) will certainly influence the integration of UAVs. It is difficult to estimate the full impact or time frames associated with these types of changes.

12.3 Private Sector/Government Partnerships

The Working Group members acknowledge that to promote the UAV sector, collaborative contributions, both financial and non-financial, will be required between stakeholder organizations, such as:

- a) Industry Canada;
- b) Public Safety and Emergency Preparedness Canada (PSEPC) and its portfolio departments and agencies (such as Royal Canadian Mounted Police, Canadian Security Intelligence Service, Canada Border Services Agency);
- c) Fisheries and Oceans (including Canadian Coast Guard);
- d) DND;
- e) Environment Canada;
- f) Provincial Governments;
- g) Municipal Governments;
- h) Human Resources and Social Development Canada (HRSDC);
- i) Natural Resources Canada (NRCAN);
- j) Defence Research and Development Canada (DRDC);
- k) NRC; and
- l) Academia.

The UAV sector provides considerable opportunities for economic growth, innovation spillovers, and contributions to achieving strategic national objectives. Many countries are now attempting to organize, focus and promote their unmanned vehicle sectors. The emergent nature of UAV technology also indicates that competitive advantage can be gained through innovation and product differentiation as opposed to competing through pure economies of scale.

12.3 UAV Sector Association

The Working Group believes that national UAV Sector Associations are essential if Canada is to maintain and increase the international competitiveness of the Canadian UAV sector. The coming years may, or may not, see a single entity emerge that could provide a single point of contact for Transport Canada on regulatory-related issues. Although it is not an association, CCUVS may also be able to support this role. Prior to the UAV industry accepting the responsibility for administering some portion of the UAV regulatory infrastructure, it is the recommendation of the Working Group that a UAV Sector group work with Transport Canada to develop the regulatory structure.

12.3.1 *Airworthiness Design Standards*

The Working Group notes that one of the early tasks to be undertaken by the UAV Industry, in collaboration with Transport Canada, is the development or adoption of airworthiness design standards for unmanned aircraft systems with maximum take-off weights of the UAV not exceeding 150 Kg. Collaboration with Transport Canada will be essential in the development of proposed design standards. The Working Group recommends that the concept for this design standard be reviewed and approved by Transport Canada before work commences.

Examples of advantages to Industry of an Airworthiness Design Standard:

- a) Provides an enabler to domestic and international operations;
- b) Facilitates technology commercialization;
- c) May aid in securing liability insurance;
- d) Simplifies design process;
- e) Improves competitive position against non-standardized products;
- f) Improved customer acceptance;
- g) Simplifies procurement;
- h) Simplifies approval process for operations; and
- i) Sustainable, profitable industry.

Examples of advantages to Transport Canada / Government of Canada of an Airworthiness Design Standard:

- a) Simplifies approval process for operations;
- b) Meets Flight 2010 objectives;
- c) Reduces required Transport Canada resources;
- d) Public interest; and
- e) Sustainable industry.

12.4 *Role of Government in Enabling Technologies*

Transport Canada and Industry Associations will need to work closely in the logical development of enabling technologies. These technologies are a key ingredient to achieve the desired end state of safe airspace integration of unmanned air vehicles, and therefore, are very important to Transport Canada. As well and concurrently, the promotion (funding of Research and Development, Test and Evaluation and commercialization of technology) of these technologies within industry will be largely assisted by other Government departments.

For example, Industry Canada has a key role to play. Industry Canada needs to have a thorough knowledge of this industry and its enabling technologies to ensure that it supports UAVs properly when this sector seeks government funds through programs such as the Strategic Aerospace and Defence Initiative (SADI) and Industrial and Regional Benefits (IRB). Correctly funded and directed through such programs, Industry Associations will be able to grow the Canadian unmanned air vehicle sector effectively to help it become a strong economic engine in Canada, both as a national solution provider and as a high tech exporter to the world.

In a similar fashion, government agencies from National Research Council to Public Safety and Emergency Preparedness Canada to Human Resources and Social Development Canada to Natural Resources Canada, need to be apprised of unmanned aircraft systems and the requisite enabling technologies to ensure that they use them

to further their individual mandates in a coherent fashion that will benefit the optimum number of Government departments whilst growing a profitable national high tech sector. This is not an overly complex situation and can be accomplished with national industry group leadership. Nonetheless, it is crucial that Transport Canada recognize its important seminal role.

12.5 Transport Canada Contribution

Government departments will follow Transport Canada leadership when Transport Canada states clearly that the development of enabling technologies is a key ingredient in this inter- departmental initiative to both grow an industry while meeting national safety, security and quality of life mandates.

The new regulatory framework for UAVs will demand that UAV operators develop and maintain an effective Safety Management System (SMS) program. It will also require that there be an increase in present resource allocation and monetary expenditures to the Minister.

With the increased demand for the utilization of the airspace, combined with the introduction of novel technologies, maintenance of current levels of safety will require the introduction of additional resources for both Transport Canada and the industry. The Working Group recommends the creation of a dedicated Transport Canada multi-disciplinary UAV team, under a program manager, to implement the recommendations of this report and to pool knowledge, experience and expertise to avoid duplication and to harmonize with international approaches.

13.0 NEW TERMINOLOGY AND DEFINITIONS

While the Working Group has made every effort to avoid creating an over-abundance of new terms and definitions, it should be noted that there might be a need in the future to introduce and define additional new terms.

13.1 Amended Definitions

The Working Group recommends that the following definitions, currently contained in subsection 101.01(1) of the CARs, be amended:

“category” - means

- (a) when used in reference to flight crew licensing, the classification of aircraft as an aeroplane, a balloon, a glider, a gyroplane, a helicopter, an ultra-light aeroplane or an unmanned aircraft system and
- (b) when used in reference to the certification of aircraft, a grouping of aircraft based upon intended use or operating limitations such as normal, utility, aerobatic, commuter and transport.

“crew member” - means

- (a) a person assigned to duty in an aircraft during flight time or
- (b) in the case of an unmanned aircraft system, a person assigned to duty with respect to the operation of an unmanned aircraft system during flight time.

“unmanned air vehicle” - means an aircraft, other than a model aircraft, that is designed to fly without a human operator on board.

13.2 New Terminology

The Working Group recommends the following new terms and definitions be incorporated into the *Canadian Aviation Regulations*:

“beyond visual range” - means any distance at which sense and avoid cannot be performed through visual contact.

“communications link” - means the mechanism for command, control and information transmitted or received by the unmanned air vehicle.

“control station” - means the equipment remote from the unmanned air vehicle from which its flight is controlled and/or monitored.

“line of sight” - means a direct point-to-point contact between a transmitter and a receiver.

“sense and avoid” - means the ability to detect conflicting traffic or other object(s) and take the appropriate action to avoid collision.

“unmanned aircraft system” - means the unmanned air vehicle(s), control station(s) and any other elements required for flight.

“visual contact” - in respect of an unmanned air vehicle means unaided (other than corrective lenses) direct visual observation by a UAV crew member.

“visual range” – in respect of an unmanned air vehicle means the maximum distance at which sense and avoid can be performed by visual contact.

14.0 UNMANNED AIR VEHICLE CLASSIFICATION

Given their diversity in airframe types, weight, size, speed, propulsion systems, payload carrying capabilities, mission profiles, degree of automation and data acquisition capabilities, it would be unreasonable to subject all unmanned aircraft systems to a single set of requirements. UAVs can be land, air or ship-launched. They can carry internal or external payload equipment. Input from the electronic sensors is either processed on board, so that the aircraft’s computers can evaluate the flight environment and forward the data to the UAS pilot, or processed on the ground.

In general terms, the Working Group concluded that classification should be based on maximum take-off weight and type of operation, i.e., within or beyond visual range. It became apparent during Working Group discussions that there were two maximum take-off weights that merited consideration. One weight is found in the CARs (35 Kg), and the other is found in EASA and NATO documents (150 Kg). Additional classification criterion that was considered is found in Appendix C.

What is often considered a “model aircraft” is, in fact, an “unmanned air vehicle” by definition, however, subsection 101.01(1) of the CARs defines model aircraft as:

"model aircraft" - means an aircraft, the total weight of which does not exceed 35 Kg (77.2 pounds), that is mechanically driven or launched into flight for recreational purposes and that is not designed to carry persons or other living creatures.

The Working Group recommends that 35 Kg and 150 Kg MTOW delineations should be used for UAVs. Within the 35 Kg classification there would be those UAVs “equivalent” to existing model aircraft that have no greater capability (i.e., operated within visual range), and those that operate beyond visual range, which would be subject to more rigorous standards.

The 150 Kg weight comes from EASA and NATO documents. UAV systems with a MTOW of less than 150 Kg are exempt from regulation by EASA. NATO’s UAV Systems Airworthiness Requirements (USARs) are intended for certification of fixed-wing military UAV systems with a MTOW between 150 and 20,000 Kg. It seemed logical that the 150 Kg weight would be a reasonable one to adopt in the interest of harmonization. This weight limit may change in future once ICAO has developed SARPs for unmanned aircraft systems.

15.0 AIRCRAFT REGISTRATION AND MARKS

The Working Group identified the following recommendations concerning UAV registration and marks:

- a) All UAVs should be marked and registered;
- b) Where it is not practical to carry a Certificate of Registration on board the aircraft, the Certificate will be accessible to the pilot-in-command during flight operations;
- c) Aircraft identification plates may be in some form other than conventional identification plates, e.g., a microchip;
- d) Given the diversity of unmanned aircraft in size and configuration, flexibility will be given for mark specifications;
- e) New “aircraft” boxes need to be added to the Application for registration of aircraft (form 26-0522) as follows: “manned” and “unmanned”; and
- f) A dedicated sequence of marks (i.e., C-?xxx) for UAVs is desirable because it would:
 - i. Facilitate potential future registering of UAVs by industry;
 - ii. Identify to other airspace users that the aircraft is unmanned;
 - iii. Identify to NAV CANADA that the aircraft is unmanned; and
 - iv. Identify to Search and Rescue that the aircraft is unmanned (e.g., not looking for survivors).

15.1 Regulatory Amendments

Aircraft Identification Plates

201.01(4) An aircraft identification plate attached to an aircraft, and in the case of unmanned air vehicles that are not large enough to carry a conventional identification plate, some other means of identification that shall have the following information permanently contained, etched, engraved or stamped on it, namely,

Carrying Certificate of Registration on Board the Aircraft

202.26 No person shall operate an aircraft in Canada, other than an aircraft referred to in [subsection 202.43\(1\)](#), or a Canadian aircraft outside Canada unless:

- (a) the certificate of registration issued in respect of the aircraft is carried on board the aircraft,
- (b) in the case of an unmanned air vehicle, if not carried on board the aircraft, is accessible to the pilot-in-command.

222.01 Specifications for Marks

Except in the circumstances described in [subsection 202.07\(1\)](#) of the *Canadian Aviation Regulations* the marks shall be displayed on and affixed to a Canadian aircraft as follows:

(p) Where the available surface of an unmanned air vehicle is not sufficient for the display of full size marks in accordance with the aircraft category, the dimensions of the letters in the marks must be as large as possible, consistent with the size of the unmanned air vehicle.

The Working Group has recommended that some UAVs will require flight authorities, while others will not (refer to Table 18.1). To accommodate this, section 222.16(1)(e) will need to be amended as follows:

222.16 Registration Requirements

- (1)** An application for the registration of an aircraft, other than an application for provisional registration, shall meet the following requirements:

(e) except in the case of an ultra-light aeroplane or an unmanned air vehicle with a maximum take-off weight that does not exceed 35 Kg, the aircraft shall be eligible for a flight authority pursuant to [Part V](#) of the *Canadian Aviation Regulations*

16.0 PILOT AND SYSTEM OPERATOR COMPETENCIES AND LICENSING

The Working Group identified the following recommendations concerning UAS pilot competencies and licensing.

16.1 Pilot Licensing Overview

- a) All UAS pilots should be licensed by Transport Canada. The term “pilot” implies responsibility and professionalism. The pilot-in-command is responsible for the aircraft whether or not the pilot is external to the aircraft. The use of the term “pilot”, however, is not meant to suggest that in all cases a UAS pilot is qualified as a crew member of a manned aircraft.
- b) In general, pilot licensing requirements are commensurate with the aircraft weight, performance characteristics and type of operation.
- c) Operators of launch systems, arresting hooks, observers, payload operators and mission planners will not require licensing certification. These personnel will need to be appropriately trained by the UAV operator, manufacturer or a third party.
- d) The flight training, knowledge, skills and abilities for all personnel conducting UAV flight operations must be appropriate to the UAV for all locations and airspaces within which the UAV will be operated.

16.2 Competencies

16.2.1 Age

- a) Minimum age requirements should be established for UAS pilots.
- b) Minimum age requirements will not be imposed for operators of launch and recovery systems, observers, payload operators and mission planners.

16.2.2 Medical Fitness

- a) A Medical Certificate will be a necessary prerequisite for every UAS Pilot Permit or Licence.
- b) The existing structure of medical categories (i.e., 1 to 4) will be applied.
- c) Requirements of medical fitness will not be imposed for operators of launch and recovery systems, observers, payload operators and mission planners.

16.2.3 Knowledge

- a) All UAS pilots will be required to complete a specified number of hours of pilot ground school instruction and successfully complete a Transport Canada written examination.

16.2.4 *Experience*

- a) All UAS pilots will require system-specific training.
- b) Minimum experience requirements are not specified for Unmanned Aircraft System Pilot Permit holders. The experience level will be that required to qualify for a type rating.
- c) Minimum experience requirements for Private and Commercial Pilot Licence holders are those specified in Part IV of the *Canadian Aviation Regulations*. Additional system-specific training will also have to be obtained, resulting in a type rating endorsed on the pilot licence.

16.2.5 *Skill*

- a) All UAS pilots will have to demonstrate competency in the ability to perform normal and emergency procedures appropriate to the particular type of UAV.

16.2.6 *Currency*

- a) Currency and proficiency for UAS Pilots will be maintained in accordance with section 401.05 of the *Canadian Aviation Regulations*. Changes may have to be made in the future to prevent the use of unmanned air vehicles to maintain recency for a Private or Commercial Pilot Licence.

16.3 *Licensing*

16.3.1 *Student Pilot Permits*

- a) Student Pilot Permits will not be required for persons wishing to obtain an Unmanned Aircraft Systems Pilot Permit.

16.3.2 *Unmanned Aircraft System Pilot Permits*

- a) “Made in Canada” licensing solutions should be available for pilots conducting specific operations with specific types of UAVs. Two different types of Unmanned Aircraft System Pilot Permits are introduced in Section 16.5.

16.3.3 *Pilot Licences Endorsed with UAV Type Ratings*

- a) Pilots wishing to conduct UAV operations, other than those associated with holding an Unmanned Aircraft System Pilot Permit, will be required to obtain a traditional (i.e., “manned”) Private or Commercial Pilot Licence with UAV type ratings endorsed on the licence. This approach should provide opportunities for cross-border operations since Canada’s pilot licences conform to the standards set forth in ICAO Annex 1. Additionally, it ensures that UAS pilots and manned aircraft pilots sharing the airspace will have met the same basic requirements (e.g., private and commercial pilot licences).
- b) Pilots operating optionally piloted UAVs will be required to hold “manned” pilot licences while they are operating the aircraft as a manned aircraft.

16.3.4 Ratings

- a) Ratings added to Unmanned Aircraft System Pilot Permits:
 - i. Type rating - required for each type of UAV.
- b) Ratings added to Private and Commercial Pilot Licences:
 - i. Type rating - required for each type of UAV.
 - ii. IFR ratings.
- c) Pilots who intend to fly a UAV under instrument flight rules will be required to obtain an instrument rating endorsed on their Private or Commercial Pilot Licence. Instrument ratings will not be endorsed on Unmanned Aircraft System Pilot Permits.

16.4 Training

Unmanned aircraft system pilots may have to deal with wide variations in unmanned air vehicle performance capabilities and applications. The approach to training UAS pilots however, should not differ significantly from that currently applied to “manned aircraft”, since fundamental knowledge and skills are a basic requirement for all pilots to assure a safe and effective operating environment for the entire aviation community. As a pilot progresses from ab initio training, the curriculum becomes more and more operation and type specific.

- a) For private and commercial pilot licences where manned pilot qualifications are a pre-requisite, training will be provided by manned flight schools.
- b) UAV system-specific knowledge will be supplied to the pilot by UAV operators, manufacturers or third parties. Instructors providing system-specific ground training will not require licensing certification.
- c) With some of the UAV related system-specific flight training being a fundamental shift away from the skills required to fly a manned aircraft, UAV operators, manufacturers or third parties should supply this training to the pilot. This training may be simulator training, airborne training or a combination of both. Instructors providing system-specific flight training will require a Pilot Permit or Licence endorsed with the type of UAV used for the training.
- d) Class conversions, night training, multi-engine training and high-performance training will be incorporated into type training for UAS pilots.
- e) UAV system-specific system flight tests /skill tests/ proficiency checks leading to a type rating will be conducted by UAV operators, manufacturers or third parties.
- f) UAV specific flight training organizations, training courses and synthetic flight training devices may be approved by Transport Canada.
- g) Specific operational training (e.g., requirements unique to the UAV operation) will be supplied to the pilot by the operator. UAV operators will need to establish the qualifications and levels of training and proficiency that are required for pilots and system operators employed within their organizations.

16.4.1 Regulatory Amendments

425.21 Qualifications of Flight Instructors

(7) A person who conducts flight training toward the issuance of an aircraft type rating shall:

(f) In the case of an unmanned air vehicle, be the holder of an Unmanned Aircraft System Pilot Permit or a Private or Commercial Pilot licence, and be qualified on the type of unmanned aircraft system used for the training.

16.5 Unmanned Aircraft System Pilot Permits

16.5.1 Pilot Permit – Unmanned Aircraft System - Restricted to Visual Range

Privileges:

- UAV does not exceed 35 Kg maximum take-off weight.
- Restricted to visual range operations.
- VFR only.
- Commercial operations.

Requirements:

- a) Private pilot groundschool – 40 hours. Helicopter groundschool course for rotary-wing UAVs; aeroplane groundschool course for all other categories and eventually a separate powered-lift groundschool course for powered-lift UAVs.
- b) Pass a Transport Canada private pilot written exam appropriate to category (i.e., helicopter, aeroplane, powered-lift).
- c) Practical training and additional unmanned aircraft system knowledge provided by operator, manufacturer, or third party - resulting in a type rating.
- d) Medical fitness – Category 4 Self-declaration with 60 months revalidation.
- e) Minimum experience requirements – None specified; experience level will be that required to qualify for a type rating.
- f) Minimum currency requirements – comply with existing CAR requirements.
- g) Demonstration of skill – assessment of proficiency by trainer.
- h) Minimum age requirement – 16 yrs.

16.5.2 Pilot Permit – Unmanned Aircraft System

Privileges:

- UAV does not exceed 35 Kg maximum take-off weight.
- VFR only.
- Commercial operations.

Requirements:

- a) Commercial pilot groundschool – 80 hours. Helicopter groundschool course for rotary-wing UAVs; aeroplane groundschool course for all other categories and eventually a separate powered-lift groundschool course for powered-lift UAVs.
- b) Pass a Transport Canada commercial pilot written exam appropriate to category (i.e., helicopter, aeroplane, powered-lift).
- c) Practical training and additional unmanned aircraft system knowledge provided by operator, manufacturer, or third party - resulting in a type rating.
- d) Medical fitness – Category 4 Self-declaration with 60 months revalidation.
- e) Minimum experience requirements – None specified; experience level will be that required to qualify for a type rating.
- f) Minimum currency requirements – comply with existing CAR requirements.
- g) Demonstration of skill – assessment of proficiency by trainer.
- h) Minimum age requirement – 17 yrs.
 - Radiotelephone Operator’s Restricted Certificate – Aeronautical will be required for both Permits.

16.6 Summary of Proposed Permits and Licences

Table 16-6 Summary of Proposed Permits and Licences

<i>Type of Permit or Licence</i>	<i>Privileges</i>	<i>Ratings</i>
Unmanned Aircraft System Pilot Permit – Restricted to Visual Range	UAV does not exceed 35 Kg MTOW Visual range operations VFR only Commercial Operations Conduct type rating training for this permit only	Each individual type of UAV No other ratings may be endorsed on permit
Unmanned Aircraft System Pilot Permit	UAV does not exceed 35 Kg MTOW Beyond visual range operations VFR only Commercial Operations Conduct type rating training	Each individual type of UAV No other ratings may be endorsed on permit
CARs Part IV Private Pilot Licence - Aeroplane	Existing Part IV privileges All UAVs ² endorsed on licence, except rotary-wing and powered-lift UAVs Private operations ¹ Conduct type rating training	Each individual type of UAV May be endorsed with IFR rating

<i>Type of Permit or Licence</i>	<i>Privileges</i>	<i>Ratings</i>
CARs Part IV Private Pilot Licence - Helicopter	Existing Part IV privileges All rotary wing UAVs endorsed on licence Private operations ¹ Conduct type rating training	Each individual type of UAV May be endorsed with IFR rating
CARs Part IV Private Pilot Licence – Powered Lift (standards yet to be developed)	Privileges TBD All powered-lift UAVs endorsed on licence Private operations ¹ Conduct type rating training	Each individual type of UAV May be endorsed with IFR rating
CARs Part IV Commercial Pilot Licence - Aeroplane	Existing Part IV privileges All UAVs ² endorsed on licence, except rotary-wing and powered-lift UAVs Commercial operations Conduct type rating training	Each individual type of UAV May be endorsed with IFR rating
CARs Part IV Commercial Pilot Licence - Helicopter	Existing Part IV privileges All rotary wing UAVs endorsed on licence Commercial operations Conduct type rating training	Each individual type of UAV May be endorsed with IFR rating
CARs Part IV Commercial Pilot Licence - Powered – lift (standards yet to be developed)	Privileges TBD All powered-lift UAVs endorsed on licence Commercial operations Conduct type rating training	Each individual type of UAV May be endorsed with IFR rating

Notes:

1. Private operations would include operations such as a farmer conducting crop-dusting his own property. It is anticipated that most UAV operations will be commercial in nature.
 2. “All UAVs” - means the pilot has the privilege of operating the types of UAV endorsed on the licence/permit.
- “Aeroplane” requirements will include all categories of aircraft other than rotary-wing and powered-lift.
 - Since there is an established network of flight training schools across Canada that conduct ground school and flight training for private and commercial pilot licences, it is assumed that it should not be an undue hardship to obtain access to the required training.
 - It is important to note that multiple aircraft may be controlled from one control station (and one pilot) and/or multiple stations and pilots may share control of a single aircraft.

17.0 MAINTAINER COMPETENCIES AND LICENSING

The Working Group identified the following recommendations concerning UAS maintainer competencies and licensing.

Unmanned aircraft system maintainers should be licensed by Transport Canada, with the exception of where the UAV has a MTOW that does not exceed 35 Kg, the UAV is operated within visual range and under VFR. In this case, the system maintenance could be performed by the UAV owner/operator and an AME licence would not be required. The owner/operator would assume sole responsibility for maintenance of the unmanned aircraft system, including fitness of flight of the air vehicle.

17.1 AME Licence Ratings

The following table, from CARs Chapter 566, Appendix A, summarizes the requirements for AME licence ratings. A new unmanned aircraft system rating is being recommended. Unmanned aircraft system maintainers would need type training for each different UAV type. Level of competencies may be similar to the model applied to the AME Licence with a balloon rating.

Table 17-1 Table of Requirements - Appendix A

Rating	Scope of Privileges	Basic Training	Aviation Maintenance Experience			Regulatory Requirements Exam
			Total ¹	Specialty ²	Civil	
M1	Small aircraft ³	Yes	48 Month ⁴	12 Month	6 Month	Yes
M2	Large aircraft ³	Yes	48 Month	12 Month	6 Month	Yes
E	Electronics	Yes	48 Month	12 Month	6 Month	Yes
S	Structures	Yes ⁵	36 Month	24 Month	6 Month	Yes
B	Balloons	Yes ⁶	120 hr.	120 hr.	120 hr.	Yes ⁷
U	UAVs	Yes ⁸	TBD	TBD	TBD	Yes ⁹

U = Unmanned Aircraft System maintainers

Notes:

1. Total experience may be reduced by one month for each 100 hours of approved basic training, up to a maximum of 50 percent of the total experience requirement for the rating. This does not apply to the balloon rating.
2. Specialty and civil aviation experience are required elements of the total aviation maintenance experience requirement (e.g. M1 requires a total of 48 months experience, 12 of which must be on small aircraft, and 6 must be in civil aviation). No training credit is applicable to these experience requirements.
3. For ease of reference, the M1 and M2 ratings have been identified as small and large aircraft. Actual definitions for all ratings are specified in 566.03(8).
4. Maintenance of [unmanned aircraft systems](#), ultra-light, advanced ultra-light, amateur-built, or owner maintained aircraft, does not qualify for experience credit.
5. The basic training requirement for a structures rating will come into effect 1 September 2001.
6. The basic training for balloon applicants consists of an acceptable course in balloon maintenance.
7. The regulatory examination balloons consists of a subset of the standard regulatory requirements examination

8. The basic training for unmanned aircraft system applicants would consist of an acceptable course in unmanned aircraft system maintenance.
9. The regulatory examination for unmanned aircraft systems would consist of a subset of the standard regulatory requirements examination.

18.0 AIRWORTHINESS AND CONTINUING AIRWORTHINESS

The Working Group identified the following recommendations concerning airworthiness and continuing airworthiness.

The unmanned aircraft system “aeronautical products” that would be subject to airworthiness requirements should include both the air and ground components of the system, such as engines, airframes, command and control links and sense and avoid systems.

18.1 Flight Authority and Maintenance Requirements

The following table outlines flight authority requirements and associated maintenance requirements. It assumes that each manufacturer will produce Instructions for Continued Airworthiness (ICAs) in accordance with a Transport Canada approved/accepted standard.

It is important to note that multiple flight authorities may share common components i.e., multiple aircraft controlled from one control station and/or multiple stations sharing control of a single aircraft.

Table 18-2 Flight Authority and Maintenance Requirements

<i>Classification</i>	<i>Next step</i>	<i>Maintenance & Personnel</i>
UAV does not exceed 35 Kg MTOW and is operated within visual range	Flight authority ¹ not mandated by regulation EXCEPT Where it is determined by review of the SFOC risk assessment that a Flight authority ¹ could be issued	Unmanned aircraft system maintenance performed by owner/operator Where a Flight Authority ¹ is issued, maintenance requirements would be spelled out in the conditions attached to the Flight Authority ¹
UAV does not exceed 35 Kg MTOW and is operated beyond visual range	Flight authority ¹ mandated by regulation EXCEPT Where it is determined by review of the SFOC risk assessment that there should be relief from the Flight authority ¹ requirement ²	Unmanned aircraft system maintenance performed by an “Unmanned Aircraft System maintainer” Maintainer trained by manufacturer with a TBD number of hours of aviation experience
UAV MTOW exceeds 35 Kg up to 150 Kg ⁴	Flight Authority ¹	Unmanned aircraft system maintenance performed by an “Unmanned Aircraft System maintainer” Maintainer trained by manufacturer with a TBD number of hours of aviation experience
UAV MTOW exceeds 150 Kg ⁴	Flight Authority ³	Type design is certified by Transport Canada & complies with Article 31 of the ICAO convention Unmanned aircraft system maintenance performed by an M1 or M2 category AME licence holder

Notes:

1. The nature of the flight authority has not been specifically defined. It could be a Special Certificate of Airworthiness (C of A) – Unmanned Aircraft System or a Flight Permit. A Special C of A unique to

unmanned aircraft systems could be developed using a UAV Sector developed and Transport Canada approved airworthiness standard.

2. It may not be necessary to issue a Flight Authority to an unmanned aircraft system where it is intended that the flight terminates in the total destruction of the UAV.
3. Flight Authority would be a Certificate of Airworthiness.
4. The 150 Kg weight limit is subject to international harmonization.

18.2 Airworthiness Contribution

The following table outlines the airworthiness contribution for both the near future (next step) and distant future (long term). It assumes that subject to the SFOC risk assessment, appropriate sense and avoid techniques or equipment will be incorporated into unmanned aircraft systems to achieve collision avoidance commensurate with the class of airspace (and applicable flight rules) in which they will operate.

Table 18-3 Airworthiness Contribution

<i>Classification</i>	<i>Next step (SFOCs still required)</i>	<i>Step 2 (Future)</i>
UAV does not exceed 35 Kg MTOW and is operated within visual range	<u>Minimum requirement</u> Airworthiness input into SFOC approval process <u>Concurrent Activity</u> UAV-Industry developed and TC- approved airworthiness standards UAV manufacturer confirms compliance with standards ¹	
----- UAV does not exceed 35 Kg MTOW and is operated beyond visual range	<u>Minimum requirement</u> Increased system safety assessment by TC; input fed into SFOC approval process ² <u>Concurrent Activity</u> UAV-Industry developed and TC- approved airworthiness standards UAV manufacturer confirms compliance with standards ¹	SFOC replaced by Unmanned Aircraft System Operating Certificate (UOC) ³ Internationally harmonized standards expected to be available for UAVs 150 Kg ⁴ and below
----- UAV MTOW exceeds 35 Kg up to 150 Kg ⁴	<u>Minimum requirement</u> Increased system safety assessment by TC; input fed into SFOC approval process ² <u>Concurrent Activity</u> UAV-Industry developed and TC- approved airworthiness standards UAV manufacturer confirms compliance with standards ¹	
UAV MTOW exceeds 150 Kg ⁴	Full system safety assessment for the design of the system; input fed into SFOC approval process ²	SFOC replaced by Unmanned Aircraft System Operating Certificate (UOC) ³ Type certification Internationally harmonized standards expected to be available for UAVs above 150 Kg ⁴ CARs Part V; New Subpart created for UAVs above 150 Kg ⁴

Notes:

1. Adapted from the Advanced Ultra-light Aeroplane Design Standards model.
2. Increased Airworthiness input into SFOC approval process - for example, in order to permit the continued use of the existing SFOC process in the absence of appropriate airworthiness and operating standards and regulations, any operator wishing to fly a UAV in a sector of public airspace where other aircraft will be present and/or fly over populated areas, could be required to demonstrate the satisfactory performance of the collision avoidance capability of the system, the accuracy of air vehicle navigation and the effectiveness of the flight termination/emergency recovery system.
3. Three new operating certificates, to replace the SFOC, are being introduced in section 20.2. These certificates will address private, commercial and state use of unmanned aircraft systems.
4. The 150 Kg weight limit is subject to international harmonization.

19.0 PROPOSED REGULATORY FRAMEWORK SUMMARY

Table 19-4 UAV Does Not Exceed 35 Kg MTOW, Operated Within Visual Range

<i>Classification</i>	<i>Operating Limitations</i>	<i>Flight Crew Licensing</i>	<i>Flight Authority</i>	<i>Maintainer Certification</i>	<i>Airworthiness Contribution</i>	<i>Operating Certificate</i>
UAV does not exceed 35 Kg MTOW	Visual range VFR	Pilot Permit – Unmanned Aircraft System - Restricted to Visual Range and type rating	Flight authority not mandated by regulation EXCEPT Where it is determined by review of the SFOC risk assessment that a Flight authority could be issued	Maintenance performed by owner/operator or Where a Flight Authority is issued, maintenance requirements would be spelled out in the conditions attached to Flight Authority	Airworthiness input into SFOC approval process ¹ UAV-Industry developed and TC approved airworthiness standards ¹ UAV manufacturer confirms compliance with standards ¹ ----- ----- Internationally harmonized standards expected to be available for UAVs 150 Kg and below ²	SFOC ¹ SFOC replaced by Unmanned Aircraft System Operating Certificate (UOC) ²
<p>Notes:</p> <ol style="list-style-type: none"> 1. Near future (short-term) 2. Future (long-term) 						

Table 19-5 UAV Does Not Exceed 35 Kg MTOW

<i>Classification</i>	<i>Operating Limitations</i>	<i>Flight Crew Licensing</i>	<i>Flight Authority</i>	<i>Maintainer Certification</i>	<i>Airworthiness Contribution</i>	<i>Operating Certificate</i>
UAV does not exceed 35 Kg MTOW	VFR ----- -- IFR	Pilot Permit – Unmanned Aircraft System and type rating ----- ---- Private or Commercial Pilot Licence with type and IFR ratings	Flight authority mandated by regulation EXCEPT Where it is determined by review of the SFOC risk assessment that there should be relief from the Flight authority requirement	Maintenance performed by an “Unmanned Aircraft System maintainer” Maintainer trained by manufacturer with a TBD number of hours of aviation experience	Increased system safety assessment by TC; input fed into SFOC approval process ¹ UAV-Industry developed and TC approved airworthiness standards ¹ UAV manufacturer confirms compliance with standards ¹ ----- --- Internationally harmonized standards expected to be available for UAVs 150 Kg and below ²	SFOC ¹ SFOC replaced by Unmanned Aircraft System Operating Certificate (UOC) ²
<p>Notes:</p> <p>1. Near future (short- term)</p> <p>2. Future (long-term)</p>						

Table 19-6 UAV MTOW Exceeds 35 Kg up to 150 Kg

<i>Classification</i>	<i>Operating Limitations</i>	<i>Flight Crew Licensing</i>	<i>Flight Authority</i>	<i>Maintainer Certification</i>	<i>Airworthiness Contribution</i>	<i>Operating Certificate</i>
UAV MTOW exceeds 35 Kg up to 150 Kg		Private or Commercial Pilot Licence with applicable ratings	Flight Authority	Maintenance performed by an “Unmanned Aircraft System maintainer” Maintainer trained by manufacturer with a TBD number of hours of aviation experience	Increased system safety assessment by TC; input fed into SFOC approval process ¹ UAV-Industry developed and TC approved airworthiness standards ¹ UAV manufacturer confirms compliance with standards ¹ ----- ----- Internationally harmonized standards expected to be available for UAVs 150 Kg and below ²	SFOC ¹ SFOC replaced by Unmanned Aircraft System Operating Certificate (UOC) ²

Notes:

1. Near future (short- term)
2. Future (long-term)

Table 19-7 UAV MTOW Exceeds 150 Kg

<i>Classification</i>	<i>Operating Limitations</i>	<i>Flight Crew Licensing</i>	<i>Flight Authority</i>	<i>Maintainer Certification</i>	<i>Airworthiness Contribution</i>	<i>Operating Certificate</i>
UAV MTOW exceeds 150 Kg		Private or Commercial Pilot licence with applicable ratings	Flight Authority	Type design is certified by TC & complies with Article 31 of ICAO Maintenance performed by an M1 or M2 category AME licence holder	Full system safety assessment for the design of the system; input fed into the SFOC approval process ¹ ----- --- Type certification ² Internationally harmonized standards expected to be available for UAVs above 150 Kg ² CARs Part V; New Subpart created for UAVs above 150 Kg ²	SFOC ¹ SFOC replaced by Unmanned Aircraft System Operating Certificate (UOC) ²

Notes:

1. Near future (short- term)
2. Future (long-term)

20.0 CARs PART VI

Unmanned air vehicles 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 air vehicles. 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 Regulations* that were not written to be aviation specific, but may be applicable to unmanned air vehicles, such as standards dealing with solar cells, fuel cells, batteries etc.

As outlined in the Terms of Reference, one of the activities of the Working Group was to "document differences with manned aircraft operations and identify gaps in existing standards, regulations, policies, and advisory materials that do not address UAV operational practices". The Working Group conducted a review of the current regulations and standards that were written with unmanned air vehicles in mind (CARs Part VI, Subpart 3) as well as a review of Part VI, Subparts 2, 5 and 6 to determine regulatory "gaps". A review of Parts III, V and VIII are outside the scope of this Working Group.

Where an amendment to a regulation is being proposed in order to incorporate UAV operations, only the affected paragraphs of the provision are cited for the sake of brevity. 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, the proposed amendments make this assumption, unless specifically stated otherwise.

The Working Group identified the following amendments to CARs Part VI. Each Division is summarized, indicating either a recommendation to amend the section or not change the section. The proposed amended text follows the summary.

20.1 CARs Part VI, Subpart 2 – General Operating and Flight Rules

Division I – General:

- [602.01](#) - [602.04](#) - no change
- [602.05](#) - Compliance with Instructions – **amended**
- [602.06](#) - Smoking – no change
- [602.07](#) - Aircraft Operating Limitations – no change
- [602.08](#) - Portable Electronic Devices – **amended**
- [602.09](#) - Fuelling with Engines Running – no change
- [602.10](#) - Starting and Ground Running of Aircraft Engines – no change
- [602.11](#) - Aircraft Icing – **amended**
- [602.12](#) - Overflight of Built-up Areas or Open-air Assemblies of Persons during Take-offs, Approaches and Landings – **amended**
- [602.13](#) - Take-offs, Approaches and Landings within Built-up Areas of Cities and Towns – **amended**
- [602.14](#) - [602.18](#) – no change
- [602.19](#) - Right of Way - General – **amended**

- [602.20](#) - Right of Way - Aircraft Manoeuvring on Water – no change
- [602.21](#) - [602.38](#) – no change
- [602.39](#) - Transoceanic Flight – **amended**
- [602.40](#) - Landing at or Take-off from an Aerodrome at Night – **amended**
- [602.41](#) - Unmanned Air Vehicles – no change
- [602.42](#) - [602.45](#) – no change

Compliance with Instructions

602.05 (2) Every crew member on board an aircraft or in the case of an unmanned aircraft system at the control station shall, during flight time, comply with the instructions of the pilot-in-command or of any person whom the pilot-in-command has authorized to act on behalf of the pilot-in-command.

Smoking

602.06 - *It was decided that other legislation would dictate where smoking is, or is not, permitted, therefore, no changes are being recommended.*

Portable Electronic Devices

602.08 (1) No operator of an aircraft shall permit the use of a portable electronic device on board an aircraft, or at the control station of an unmanned aircraft system where the device may impair the functioning of the systems or equipment.

(2) No person shall use a portable electronic device on board an aircraft, or at the control station of an unmanned aircraft system except with the permission of the operator.

Aircraft Icing

602.11 (2) No person shall conduct or attempt to conduct a take-off of an aircraft that has frost, ice or snow adhering to any of its critical surfaces.

(3) Notwithstanding subsection (2), a person may conduct a take-off of an aircraft that has frost adhering to the underside of its wings that is caused by cold-soaked fuel, if the take-off is conducted in accordance with the aircraft manufacturer's instructions for take-off under those conditions.

(4) Where conditions are such that frost, ice or snow may reasonably be expected to adhere to the aircraft, no person shall conduct or attempt to conduct a take-off of an aircraft unless

Overflight of Built-up Areas or Open-air Assemblies of Persons during Take-offs, Approaches and Landings

602.12 (2) Except at an airport or military aerodrome, no person shall conduct a take-off, approach or landing of an aircraft over a built-up area or over an open-air assembly of persons, in a manner that is likely to create a hazard to persons or property.

(3) Except at an airport or military aerodrome, no person shall conduct a take-off, approach or landing of an aircraft over a built-up area or over an open-air assembly of persons unless that aircraft will be operated at an altitude from which, in the event of an engine failure or any other emergency necessitating an immediate landing, the aircraft can land without creating a hazard to persons or property.

Take-offs, Approaches and Landings within Built-up Areas of Cities and Towns

602.13 (1) Except if otherwise permitted under this section, [section 603.66](#) or [Part VII](#), no person shall conduct a take-off, approach or landing of an aircraft within a built-up area of a city or town, unless that take-off, approach or landing is conducted at an airport or a military aerodrome.

(2) A person may conduct a take-off or landing of an aircraft within a built-up area of a city or town at a place that is not located at an airport or a military aerodrome where...

Right of Way – General

602.19 (1) Notwithstanding any other provision of this section,

(a) the pilot-in-command of a manned aircraft or an unmanned air vehicle that has the right of way shall, if there is any risk of collision, take such action as is necessary to avoid collision; and

Note:

The intent of the proposed change to section 602.19 is to make sure that it is understood that an unmanned air vehicle, regardless of whether it resembles a glider, an aeroplane, a helicopter etc. follows the same right-of-way of rules as a glider, aeroplane, helicopter etc. that has a pilot on board the aircraft. Pilot on or off board distinctions should be transparent to both Air Traffic Control and other airspace users.

Transoceanic Flight

602.39 No pilot-in-command of a single-engined aircraft, or of a multi-engined aircraft, other than unmanned air vehicles, that would be unable to maintain flight in the event of the failure of any engine, shall commence a flight that will leave Canadian Domestic Airspace and enter airspace over the high seas unless...

Landing at or Take-off from an Aerodrome at Night

602.40 (2) A person may conduct a landing or a take-off in a heavier-than-air aircraft at night at an aerodrome that is not lighted in accordance with the requirements referred to in subsection (1) where

(a) the flight is conducted without creating a hazard to persons or property on the surface; and

(b) the aircraft is:

- (i) operated for the purpose of a police operation that is conducted in the service of a police authority,
- (ii) operated for the purpose of saving human life, or
- (iii) an unmanned air vehicle.

Division II - Operational and Emergency Equipment Requirements

- [602.57](#) - Application – no change
- [602.58](#) - Prohibition – no change

- [602.59](#) - Equipment Standards – no change
- [602.60](#) - Requirements for Power-driven Aircraft – **amended**
- [602.61](#) - Survival Equipment - Flights over Land – **amended**
- [602.62](#) - Life Preservers and Flotation Devices –no change
- [602.63](#) - Life Rafts and Survival Equipment - Flights over Water – no change

Requirements for Power-driven Aircraft

602.60 (1) No person shall conduct a take-off in a power-driven aircraft, other than an ultra-light aeroplane, unless the following operational and emergency equipment is carried on board, or in the case of an unmanned air vehicle, available at the control station:

Survival Equipment - Flights over Land

602.61 (2) Subsection (1) does not apply in respect of

- (a) A balloon, a glider, a hang glider, a gyroplane, an ultra-light aeroplane or an unmanned air vehicle.

Division III - Flight Preparation, Flight Plans and Flight Itineraries

- [602.70](#) - Interpretation – no change
- [602.71](#) - [602.76](#) - no change
- [602.77](#) - Requirement to File an Arrival Report – no change
- [602.78](#) - Contents of an Arrival Report – no change
- [602.79](#) - Overdue Aircraft Report – no change

Division IV - Pre-flight and Fuel Requirements

- [602.86](#) - Carry-on Baggage, Equipment and Cargo – no change
- [602.87](#) - Crew Member Instructions – **amended**
- [602.88](#) - Fuel Requirements – **amended**
- [602.89](#) - Passenger Briefings – no change

Crew Member Instructions

602.87 The pilot-in-command of an aircraft shall ensure that each crew member, before acting as a crew member on board the aircraft, or in the case of an unmanned air vehicle at the control station has been instructed with respect to:

- (a) the duties that the crew member is to perform; and
- (b) the location and use of all of the normal and emergency exits and of all of the emergency equipment that is carried on board the aircraft, or in the case of an unmanned air vehicle at the control station.

Fuel Requirements

602.88 (1) This section does not apply in respect of any glider, balloon or ultra-light aeroplane or an unmanned air vehicle, subject to paragraph (6).

(6) all unmanned air vehicles shall have available a sufficient amount of fuel / energy to complete the planned flight with a reserve of 15% of the total planned flight time, or 30 minutes, whichever is lesser, for propulsion and control systems.

Division V - Operations at or in the Vicinity of an Aerodrome

- [602.96](#) - [602.106](#) – no change

Division VI - Visual Flight Rules

- [602.114](#) - Minimum Visual Meteorological Conditions for VFR Flight in Controlled Airspace – **amended**
- [602.115](#) - Minimum Visual Meteorological Conditions for VFR Flight in Uncontrolled Airspace – **amended**
- [602.116](#) - VFR Over-the-Top – no change
- [602.117](#) - Special VFR Flight – **amended**

Minimum Visual Meteorological Conditions for VFR Flight in Controlled Airspace

602.114 No person shall operate an aircraft in VFR flight within controlled airspace unless

- (a) the aircraft, except for unmanned air vehicles, is operated with visual reference to the surface.

Minimum Visual Meteorological Conditions for VFR Flight in Uncontrolled Airspace

602.115 No person shall operate an aircraft in VFR flight within uncontrolled airspace unless

- (a) the aircraft, except for unmanned air vehicles, is operated with visual reference to the surface.

Special VFR Flight

602.117 (1) Notwithstanding [paragraph 602.114\(b\)](#), an aircraft may be operated in special VFR flight within a control zone if

(c) the aircraft is operated clear of cloud and for aircraft other than an unmanned air vehicles with visual reference to the surface at all times; and

Notes:

1. The title of sections 602.114 and 602.115 should be reworded since the provisions spell out both minimum visual meteorological conditions and operating conditions.
2. Unmanned air vehicles must have the ability to navigate and ensure that they do not fly into terrain. While unmanned air vehicles may not have visual reference to the surface, they are still required to follow all VFR operating rules and maintain minimum visual meteorological conditions.

Division VII - Instrument Flight Rules

- [602.121](#) - [602.131](#) – no change; **beyond the scope of the Working Group**

Notes:

1. No recommendations are being made at this time to amend the Instrument Flight Rules. For the purposes of this Working Group it was assumed that UAV operations will be conducted without amendments to the “airspace use” regulations and practices, including air traffic management. However, it is conceivable that as the industry matures, changes may be essential in order to permit routine unmanned air vehicle operations. For example, instrument approach criteria may have to be amended in order to permit autonomous unmanned air vehicles to land in zero-zero meteorological conditions or may have to be amended in order to permit an unmanned air vehicle to fly to a point in space and then be recovered by a parachute system.
2. Historically Transport Canada has never developed criteria for the development of instrument procedures; therefore, perhaps the topic of unmanned aircraft system instrument procedures could be put on the agenda for Terminal Instrument Procedures (TERPS) meetings with the FAA.

Division VIII - Radio communications – no changes

Division IX - Emergency Communications and Security – no changes

Division X - Aircraft Noise Emission Levels - Transition to Chapter 3 Aeroplanes – no changes

20.2 CARs Part VI, Subpart 3 – Special Flight Operations

DIVISION IV - MISCELLANEOUS SPECIAL FLIGHT OPERATIONS

Unmanned Air Vehicle

623.65(d) (1) The following standards apply to the application for and the operation of an unmanned air vehicle pursuant to CAR 602.41 ...

Notes:

1. The Working Group recommends that a new Subpart of the CARs be created, perhaps located in Part VI, to address operating certificates specific to unmanned aircraft systems. A new Working Group should be created to develop the operating certificate regulations and standards associated with private, commercial and state UAS operations. The decision to differentiate operating certificates assumes that the private certificate requirements would be less onerous (i.e., in the same way that there is a difference between CARs Part VI, Subpart 4 and Part VII, Subpart 5 operating certificates and requirements).
2. It may be appropriate for a Certificate of Registry to be issued to Federal and Provincial agencies operating UAS in accordance with the proposed State Operators Program for manned aircraft. There is little doubt that the specialized air services (e.g., fire suppression, police or enforcement action, wildlife/natural resource protection etc.) that are unique to government air services will be conducted utilizing UAVs.
3. A new framework for UAVs will demand that UAV operators develop and maintain an effective Safety Management System (SMS) in keeping with the principles of Transport Canada's regulated program.

New Text:

6XX.00 Unmanned Aircraft System

Operating Certificates

Private Operating Certificate

Application

This Subpart applies in respect of the operation of an unmanned aircraft system not used for hire and reward.

Certificate

No person shall operate an unmanned aircraft system under this Subpart unless the person

- (a) holds a certificate in respect of the unmanned aircraft system; and
- (b) operates the unmanned aircraft system in accordance with the conditions specified in the certificate.

Commercial Operating Certificate

Application

This Subpart applies in respect of the operation of an unmanned aircraft system used for hire and reward.

Certificate

No person shall operate an unmanned aircraft system under this Subpart unless the person

- (a) holds a certificate in respect of the unmanned aircraft system; and

(b) operates the unmanned aircraft system in accordance with the conditions specified in the certificate.

State Operating Certificate

Application

This Subpart applies in respect of the operation of an unmanned aircraft system used by a Canadian government agency.

Certificate

No person shall operate an unmanned aircraft system under this Subpart unless the person

(a) holds a certificate in respect of the unmanned aircraft system; and

(b) operates the unmanned aircraft system in accordance with the conditions specified in the certificate.

20.3 CARs Part VI, Subpart 5 – Aircraft Requirements

- [605.01](#) - Application – **amended**
- [605.02](#) - Reserved

Application

605.01 (1) This Subpart applies to

(a) persons operating Canadian aircraft other than ultra-light aeroplanes, or hang gliders; ~~and~~ or unmanned aircraft systems that do not require a flight authority, and

(b) persons operating foreign aircraft in Canada where those persons are Canadian citizens, permanent residents or corporations incorporated by or under the laws of Canada or a province

Division I - Aircraft Requirements - General

- [605.03](#) - Flight Authority – **amended**
- [605.04](#) - Availability of Aircraft Flight Manual – **amended**
- [605.05](#) - Markings and Placards – **amended**
- [605.06](#) - Aircraft Equipment Standards and Serviceability – **amended**
- [605.07](#) - Minimum Equipment Lists – no change
- [605.08](#) - Unserviceable and Removed Equipment - General – **amended**
- [605.09](#) - Unserviceable and Removed Equipment - Aircraft with a Minimum Equipment List – **amended**
- [605.10](#) - Unserviceable and Removed Equipment - Aircraft without a Minimum Equipment List – **amended**

Flight Authority

605.03 (3) A balloon or an unmanned air vehicle may be operated without the flight authority carried on board where the flight authority is immediately available to the pilot-in-command

(a) prior to commencing a flight; and

(b) on completion of the flight

Availability of Aircraft Flight Manual

605.04 (1) No person shall conduct a take-off in of an aircraft for which an aircraft flight manual is required by the applicable standards of airworthiness, unless the aircraft flight manual or, where established under [section 604.27](#) or [Part VII](#), the aircraft operating manual is available to the flight crew members at their duty stations.

Markings and Placards

605.05 No person shall conduct a take-off in of an aircraft in respect of which markings or placards are required by the applicable standards of airworthiness unless the markings or placards are affixed to the aircraft or attached to a component of the aircraft in accordance with those standards.

Aircraft Equipment Standards and Serviceability

605.06 No person shall conduct a take-off in of an aircraft, or permit another person to conduct a take-off in of an aircraft in their custody and control, unless the aircraft equipment required by these Regulations...

Unserviceable and Removed Equipment – General

605.08 (1) Notwithstanding subsection (2) and [Sections 605.09](#) and [605.10](#), no person shall conduct a take-off in of an aircraft that has equipment that is not serviceable or from which equipment has been removed if, in the opinion of the pilot-in-command, aviation safety is affected.

(2) Notwithstanding [Sections 605.09](#) and [605.10](#), a person may conduct a take-off in of an aircraft that has equipment that is not serviceable or from which equipment has been removed where the aircraft is operated in accordance with the conditions of a flight permit that has been issued specifically for that purpose.

Unserviceable and Removed Equipment - Aircraft with a Minimum Equipment List

605.09 (1) Subject to subsection (2), where a minimum equipment list has been approved in respect of the operator of an aircraft pursuant to [subsection 605.07\(3\)](#), no person shall conduct a take-off in of the aircraft with equipment that is not serviceable or that has been removed unless

(a) the aircraft is operated in accordance with any conditions or limitations specified in the minimum equipment list; and

(b) a copy of the minimum equipment list is carried on board, or in the case of an unmanned air vehicle, a copy is immediately available to the pilot-in-command.

Unserviceable and Removed Equipment

605.10 (1) Where a minimum equipment list has not been approved in respect of the operator of an aircraft, no person shall conduct a take-off in of an aircraft with equipment that is not serviceable or that has been removed, where that equipment is required by...

(2) Where a minimum equipment list has not been approved in respect of the operator of an aircraft and the aircraft has equipment, other than the equipment required by subsection (1), that is not serviceable or that has been removed, no person shall conduct a take-off in of the aircraft unless.

Division II - Aircraft Equipment Requirements

- [605.14](#) - Power-driven Aircraft - Day VFR – **amended**
- [605.15](#) - Power-driven Aircraft - VFR OTT – **amended**
- [605.16](#) - Power-driven Aircraft - Night VFR – **amended**
- [605.17](#) - Use of Position and Anti-collision Lights – no change

- [605.18](#) - Power-driven Aircraft - IFR - **amended**
- [605.19](#) - Balloons - Day VFR – not applicable to unmanned air vehicles
- [605.20](#) - Balloons - Night VFR - not applicable to unmanned air vehicles
- [605.21](#) - Gliders - Day VFR – **amended**
- [605.22](#) - [605.29](#) - no change
- [605.30](#) - De-icing or Anti-icing Equipment – **amended**
- [605.31](#) - Oxygen Equipment and Supply – no change
- [605.32](#) - Use of Oxygen – **amended**
- [605.33](#) - Flight Data Recorder and Cockpit Voice Recorder – no change
- [605.34](#) - Use of Flight Data Recorders and Cockpit Voice Recorders – no change
- [605.35](#) - Transponder and Automatic Pressure-altitude Reporting Equipment – no change
- [605.36](#) - Altitude Alerting System or Device – **amended**
- [605.37](#) - Ground Proximity Warning System – no change
- [605.38](#) - ELT – **amended**
- [605.39](#) - Use of ELTs - no change
- [605.40](#) - ELT Activation – no change
- [605.41](#) - Third Attitude Indicator – no change

Power-driven Aircraft - Day VFR

605.14 Subject to Section 605.XX, No person shall conduct a take-off in of a power-driven aircraft for the purpose of day VFR flight unless it is equipped with...

Power-driven Aircraft - VFR OTT

605.15 (1) Subject to Section 605.XX, No person shall conduct a take-off in of a power-driven aircraft for the purpose of VFR OTT flight unless it is equipped with...

Power-driven Aircraft - Night VFR

605.16 (1) Subject to Section 605.XX, No person shall conduct a take-off in of a power-driven aircraft for the purpose of night VFR flight, unless it is equipped with...

Power-driven Aircraft - IFR

605.18 Subject to Section 605.XX, No person shall conduct a take-off in of a power-driven aircraft for the purpose of IFR flight unless it is equipped with...

Note: A new section (605.XX) will need to be developed which addresses system capability requirements for UAS.

New Text

System Capability Requirements

Unmanned Aircraft System

605.XX No person shall conduct the take-off of an unmanned air vehicle unless there is a means of:

- (a) controlling the flight of the unmanned air vehicle;
- (b) monitoring the unmanned air vehicle;
- (c) communication, as required by the Class of airspace;
- (d) collision detection and avoidance; and
- (e) detecting hazardous environmental flight conditions.

Note: The above list is a performance-based list of system capability requirements for unmanned aircraft systems. For example, “controlling the flight of the UAV” could include equipment that would measure altitude, automatically hold altitude etc. “Monitoring the UAV”, either remotely or onboard, could include equipment that would monitor the health of the UAV, ensure the UAV is operated within its flight envelope, monitor the telemetry of the UAV, receive an indication of remaining endurance, etc. This list may not be exhaustive, and in the future there may be a need to develop associated standards.

De-icing or Anti-icing Equipment

605.30 No person shall conduct a take-off or continue a flight in of an aircraft where icing conditions are reported to exist or are forecast to be encountered along the route of flight unless...

Use of Oxygen

605.32 (3) The pilot at the flight controls of in an aircraft shall use an oxygen mask if...

Altitude Alerting System or Device

605.36 (1) Subject to subsection (2), no person shall conduct a take-off in of a turbo-jet-powered aeroplane unless it is equipped with an altitude alerting system or device, and in the case of an unmanned aircraft system annunciated at the control station, that conforms to the [Aircraft Equipment and Maintenance Standards](#).

ELT

605.38 (1) Subject to subsection (3) and subsection (5) no person shall operate an aircraft, unless it is equipped with one or more ELTs in accordance with subsection (2).

(5) No person shall operate an unmanned air vehicle equipped with an ELT.

Division III - Aircraft Maintenance Requirements

- [605.84](#) - Aircraft Maintenance - General – **amended**; additional amendments may be required in future
- [605.85](#) - Maintenance Release and Elementary Work – not assessed
- [605.86](#) - Maintenance Schedule – not assessed
- [605.87](#) - Transfer of Aeronautical Products between Maintenance Schedules – not assessed
- [605.88](#) - Inspection after Abnormal Occurrences – not assessed

Note: It is beyond the scope of the Working Group to assess Sections 605.84 – 605.88 for unmanned aircraft system operations. These sections may need to be amended at a future date.

Aircraft Maintenance - General

605.84 (1) Subject to subsections (3) and (4), no person shall conduct a take-off or permit a take-off to be conducted in of an aircraft that is in the legal custody and control of the person, other than an aircraft operated under a special certificate of airworthiness in the owner-maintenance or amateur-built classification, unless the aircraft ...

Division IV - Technical Records

- [605.92](#) - Requirement to Keep Technical Records – **amended**
- [605.93](#) - Technical Records - General – no change

Note: Schedules I and II have not been assessed to determine if changes are required for unmanned air vehicle operations, since it is beyond the scope of the Working Group. Sections 605.96 and 605.97 would have to be revised accordingly.

- [605.94](#) - Journey Log Requirements - **amended**
- [605.95](#) - Journey Log - Carrying on Board – **amended**
- [605.96](#) - Requirements for Technical Records Other Than the Journey Log – no change
- [605.97](#) - Transfer of Records – no change
- [Schedule I](#) - Journey Log – not assessed
- [Schedule II](#) - Technical Record for an Airframe, Engine, Propeller or Component – not assessed

Requirement to Keep Technical Records

605.92 (3) In the case of a balloon, glider or an unmanned aircraft system, or an aircraft operated under a special certificate of airworthiness in the owner-maintenance or amateur-built classification, all entries in respect of the technical records referred to in paragraphs (1)(b) and (c) may be kept in the journey log.

Journey Log - Carrying on Board

605.95 (2) A person may conduct a take-off in of an aircraft without carrying the journey log on board where

- (a) it is not planned that the aircraft will land and shut down at any location other than the point of departure; or
- (b) the aircraft is a balloon or an unmanned air vehicle and the journey log is immediately available to the pilot-in-command
 - (i) prior to commencing a flight, and
 - (ii) on completion of the flight.

20.4 CARs Part VI, Subpart 6 – Miscellaneous

- [606.01](#) -Munitions of War – no change
- [606.02](#) - Liability Insurance – no change

Note: The Working Group does not feel qualified to discuss any change to the requirement for third party liability insurance. A determination of the amount of coverage and applicability to various types of UAV operations is far beyond the scope of the Working Group.

- [606.03](#) - Synthetic Flight Training Equipment – no change

21.0 LACK OF UAS-SPECIFIC REGULATIONS AND STANDARDS

The regulatory system provided in the *Canadian Aviation Regulations* does not provide a complete set of safety requirements for unmanned aircraft systems. Components of unmanned aircraft system operations that are missing from regulation include:

- 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. While some of the technology described is developmental, the Working Group recommends that a new Working Group be created to address UAS-specific components.

22.0 OTHER STANDARDS / REGULATORY BODIES

22.1 *Unmanned Air Vehicle Occurrences*

The Transportation Safety Board (TSB) is responsible for investigating all transportation occurrences in Canada, including all aviation occurrences involving civil aircraft. The issue of reporting unmanned aircraft occurrences to the TSB was discussed during Working Group deliberations. The *Canadian Transportation Accident Investigation and Safety Board (CTAISB) Act* does not refer to UAVs specifically, however, at present the same criteria for “reportable aviation accidents” and “reportable aviation incidents” applies to UAVs, just like any other aircraft.

The Working Group recommends that *CTAISB Act* be reviewed to ensure that UAVs accidents and incidents are appropriately tracked and documented.

22.2 *Search and Rescue for Downed Unmanned Air Vehicles*

The Air Traffic Management Coordination Office – 1 Cdn Air Div HQ Det Ottawa, provided the Working Group with an unofficial position regarding the reporting of downed UAVs. It was felt that UAV crash reports (by the UAV operator) will have no impact on Joint Rescue Coordination Centre (JRCC) workload, and in fact, reporting UAV crashes will limit unnecessary responses. UAV crashes would have to be added to the crash registry unless immediately recovered.

The Working Group recommends that in order to avoid unnecessary searches, unmanned air vehicle crashes should be reported when there is a possibility of the crash event or wreckage being confused with a manned aircraft.

22.3 *Standards Development*

There are several groups currently working on various standards for unmanned air vehicle systems, such as:

- RTCA - Special Committee – 203
- ASTM International - Committee F-38
- SAE International - G-10 Committee
- EUROCAE -Working Group - 73

These not-for-profit corporations develop consensus-based recommendations to be used by regulatory authorities as the basis for policy, program and regulatory decisions. The Working Group recommends that Transport

Canada monitor the outputs from these international groups, as well as other bodies developing standards, such as NATO.

23.0 IMMEDIATE NEEDS

23.1 *Issue Certificates of Registration*

It is the recommendation of the Working Group that steps should be taken by Transport Canada to begin issuing Certificates of Registration as soon as practical (i.e., by June 2008), including the development of advisory material, amending applications for registration, modifying computer databases and assigning a series of marks. Notices of Proposed Amendments (NPAs), to introduce registering UAVs, need to be developed for presentation at a CARAC Part II Technical Committee Meeting.

23.2 *UAV SFOC Review Working Group*

The Working Group recognizes that the proposed regulatory amendments contained within this Final Report will take time for Transport Canada to implement. Until this goal of gaining safe and routine access to airspace is achieved, the short-term emphasis should be on ensuring that industry can safely conduct UAV operations using the SFOC procedures.

For example, in order to permit the continued use of the existing SFOC process in the absence of appropriate airworthiness and operating standards and regulations, any operator wishing to fly a UAV in a sector of public airspace where other aircraft will be present and/or fly over populated areas, must demonstrate the satisfactory performance of the collision avoidance capability of the system, the accuracy of air vehicle navigation and the effectiveness of the flight termination/emergency recovery system.

The Working Group recommends that a new Working Group be created before the end of 2007 to look at the existing UAV SFOC process with the goal of improving the process for the benefit of both Transport Canada and the UAV industry. Improvements can be made to the current approval processes in order to better respond to the demands of the industry and to reduce Transport Canada's workload.

Outputs/benefits of this new Working Group may include:

- a) Standardization;
- b) Improve efficiency and reduce the cycle time - optimize service delivery;
- c) Create a more structured application process;
- d) In keeping with Transport Canada's Government On-Line (GOL) direction, identify opportunities for submitting applications on-line. This will be beneficial to stakeholders while providing Transport Canada a mechanism to gather important statistics on UAV operations;
- e) Reduce uncertainty for industry in terms of required information to support the application;
- f) Classify types of operations and requirements; and
- g) Ensure consistent application of regulations across regions.

Proposed membership includes: DND, NAV CANADA, Transport Canada (HQ staff including Regulatory Affairs and Regional General Aviation Inspectors) and the UAV industry, including existing SFOC holders. The Working Group believes that participation of the Regional Transport Canada Civil Aviation Inspectors who are assigned responsibility for the safety oversight of unmanned air vehicles is essential to this effort.

SUMMARY

This document provides Transport Canada with consensus-based considerations and recommendations for regulatory and policy development. Industry participation in this Working Group was substantial. The

associated investment by both Industry and Government was also substantial (over 300 person days). To maintain the momentum that was generated by this activity, and to ensure continued support, the Working Group strongly recommends that the considerations and recommendations identified herein be actioned expeditiously. This includes forwarding the Final Report to the Civil Aviation Regulatory Committee (CARC) for review, as well as simultaneously creating a Working Group to review the UAV SFOC process. The Working Group members believe that if the recommendations proposed here are adopted, and the changes implemented, then Canada will have an effective regulatory system for safely integrating unmanned aircraft systems into Canadian domestic airspace.

APPENDIX A
WORKING
GROUP
MEMBERS

WORKING GROUP MEMBERS

Andrew Carryer
Unmanned Aircraft Systems Engineer
Airborne Systems
MDA (MacDonald Dettwiler and Associates)

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Sundeeep Kharey (Albert Sulmistras)
Business Development Engineer
CDL Systems

Butch Waldrum
Vice-President
SkyLink Aviation

Howard Loewen
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Greg Stewart
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Gerry Marsters
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Robert Adam (Bruce Beswick)
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Pip Rudkin
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Adam Hunt (Kevin Psutka)
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Richard Grainger
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Technical Airworthiness/Aerospace Engineering Support
Department of National Defence

Transport Canada

Terry Chilibeck - Personnel Licensing

Pierre Laroche - Airspace Standards (Bob Grant, Alain Piche)

Carlos Carreiro - Standards

Mike Palmer - National Aircraft Certification

Ian Moody - National Aircraft Certification

Mike Whissell - Aircraft Maintenance & Manufacturing

Lisa Lanthier - Special Flight Operations

Karen Tarr - Special Flight Operations; Working Group Leader

Observers

Mark Aruja
Business Development Manager
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Declan Sweeney
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Aerospace and Defence Industry Association
of Newfoundland and Labrador

Tad McGeer
President
Aerovel Corporation

Richard Barlow
President
Model Aeronautics Association of Canada

Rod Jones
Executive Director
Ontario Aerospace Council

Jean-François Lagarde
President
SauTech Innovations

Guest Speakers: Transport Canada

- Dr. Jim Pfaff, Civil Aviation & Marine Medicine
- Marc Turgeon, Regulatory Affairs

APPENDIX B
BIBLIOGRAPHY

BIBLIOGRAPHY

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- Recommended Guidance for the Training of Designated UAV Operators (DUO)

RTCA

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- Best practices for Small UAS

SAE Aerospace

ARP5707 - Pilot Training Recommendations for Unmanned Aircraft Systems Civil Operations

United States Department of Defense

Office of the Secretary of Defense - Unmanned Aircraft Systems Roadmap 2005-2030

UK Civil Aviation Authority

- CAP 722 - Policy on UAVs
- Policy on Light UAVs
- Aircraft Airworthiness Certification Standards for Civil UAVs

UVS International

UAV Related Terminology - Terms and Definitions and Abbreviations and Acronyms

APPENDIX C
UAV CLASSIFICATION
CRITERION

UAV CLASSIFICATION CRITERION

The following list of factors was considered in creating a classification system for UAVs:

Aircraft characteristics

Mass, Kinetic Energy, Speed
Powerplant (including number of engines)
Configuration (aeroplane, rotorcraft, airship, glider)
Endurance / range

Operating Environment

Range (within or beyond visual range)
Airspace
Mission (including payload)
Population density on the ground

System capability

Level of supervision (automation)
Failure modes / flight termination systems
Method of launch and recovery

APPENDIX D

TERMS OF

REFERENCE

TERMS OF REFERENCE

GENERAL AVIATION TERMS OF REFERENCE WORKING GROUP ON UNMANNED AIR VEHICLES

BACKGROUND

Unmanned air vehicles are but one of many aircraft types that use Canadian airspace daily. A present, section 602.41 of the *Canadian Aviation Regulations* (CARs) requires persons conducting unmanned air vehicle (UAV) operations to obtain and comply with the provisions of a Special Flight Operations Certificate (SFOC). These operating certificates are issued when a potential operator demonstrates that the risks associated with the operation of the UAVs can be managed to an acceptable level.

Applications for SFOCs are increasing annually and becoming increasingly diverse in terms of operational complexity, limitations and needs. A growing market utilizing medium altitude long-range endurance (MALE) UAV operations is rapidly emerging. The current approval processes and regulatory framework cannot effectively deal with this situation. Existing regulations and procedures need to be evaluated to determine the scope of required changes to address the routine integration of these aircraft into a traditionally manned aircraft environment. While the initiative will focus on the domestic operation of UAVs, any recommendations for future regulations will need to be harmonized with the legislation of other regulatory bodies to the extent practicable.

The long-term task of implementing these aircraft into the next generation air transportation system is critical to the future of aviation. The status and future direction of UAVs must be reviewed within the context of the current perspective and evolving directions of Transport Canada Civil Aviation. This includes a move towards the writing of performance-based regulations, the introduction of a systems environment, further industry delegation and risk based oversight programs.

OBJECTIVES

The primary goal of the Working Group is to define a performance-based regulatory framework for medium to long-range, medium altitude, beyond line-of sight UAV operations in Canadian airspace. This framework is to be harmonized with the United States framework to the extent necessary to permit mutual recognition of the frameworks.

SCOPE

To meet this goal, the Working Group will examine the critical issues surrounding UAV operations, review existing legislation, consider harmonization requirements and make recommendations for a regulatory framework.

The scope of this Working Group will not attempt to resolve the myriad of issues associated with disparate UAV systems, but instead will lay out a broad strategy for addressing key issues. The Working Group, therefore, will define the various UAV types of operations being realistically considered, but not necessarily provide a concept for all possible types of UAV operations in all possible airspace. The idea is to address the major issues and to find ways to manage the risks associated with UAVs without relying on segregation.

Priority will be given to operational and airworthiness issues. Initial outputs will not, however, define specific airworthiness codes or equipment standards for the aircraft, the command, control and communication systems or the ground control station. Additionally, the Working Group will not address sense and avoid systems or requirements, spectrum management, security matters (control links and control stations) or special air traffic

management considerations. While it may be necessary to discuss these aspects of UAV operations during the meetings, these topics will not be pursued in detail at this time.

General Working Group activities will include:

- Identify and characterize current and intended UAV applications.
- Identify hazards and risks unique to unmanned air vehicles operations.
- Review existing UAV regulations, standards, and policies.
- Document differences with manned aircraft operations and identify gaps in existing standards, regulations, policies, and advisory materials that do not address UAV operational practices.
- Review polices and regulatory requirements of the Federal Aviation Administration, International Civil Aviation Organization, EASA, other civil aviation organizations as well as other bodies dealing with UAVs such as ASTM, RTCA, EUROCONTROL and NATO.

Deliverables:

- Identify new terminology and definitions essential to understanding UAV operations.
- Make recommendations regarding a classification system for UAVs.
- Make recommendations regarding aircraft registration and marks.
- Identify competencies (knowledge, experience, skill, medical fitness) required for pilots, system operators and maintainers and recommend ways to qualify personnel to operate and maintain UAVs (licences, ratings).
- Make recommendations regarding the nature of the airworthiness and continuing airworthiness contribution to the overall safety target for UAVs. Specifically, the applicability of fixed airworthiness standards (based on existing airworthiness standards), variable standards (operating restrictions) or a combination of both should be addressed.
- Identify immediate needs for guidance material, policy documents, advisory circulars or Exemptions.
- Make recommendations for a regulatory framework.
- Create a roadmap that illustrates a long-term strategy for UAV safety oversight including the role of potential private sector/government partnerships.

The Working Group will endeavour to achieve workable solutions to balance UAV mission requirements with the safety issues of protection of the public and other airspace users. Recommendations will consider safety as the highest priority. The Working Group will consider both regulatory and non-regulatory approaches.

APPROACH

Establishment of the Working Group and their meetings is expected to take place during the next 12 of months and will involve regularly scheduled meetings. Teleconferences and/or video conferences may be utilized.

WORKING GROUP MEMBERSHIP

This Working Group has been designated as the “Unmanned Air Vehicle Working Group”.

Working Group membership is open to Transport Canada, DND specialists and industry. Industry membership will be coordinated by UVS Canada.

The Working Group will be comprised of, but not limited to, the following members:

Working Group Leader

Transport Canada – Karen Tarr

DND

Squadron Leader Richard Grainger

Transport Canada

Aircraft Certification Standards – Carlos Carreiro (Ian Moody, Mike Palmer – advisers)

Airspace Standards and Procedures – Alain Piche

Maintenance & Manufacturing – Mike Whissell

Personnel Licensing - Terry Chilibeck

Industry

UVS Canada – Ian Glenn

Others – TBA

Working Group members may be requested to provide supporting data to justify recommendations and should have data available during meetings.

The Working Group will strive to reach consensus, however when this is not achievable, the dissenting options will be recorded in the Working Group final report.

REPORTING

The Working Group leader is responsible for submitting reports to the Director, General Aviation regarding progress made, decisions reached, updates on schedules and issues, which remain unresolved.

Reports will be made available to the Director, Aircraft Certification and the Director, Aerodromes and Air Navigation.

In general terms, the Working Group's final report will include specific recommendations, the rationale upon which those recommendations are based and, where required, details of any dissenting points of view.

SCHEDULING

It is intended that the initial Working Group meeting will be held in January, 2007, however, a preliminary teleconference is expected to be held in December 2006.

It is anticipated that the Working Group will present an interim report by 31 March 2007 and submit a final report to the Director, General Aviation by 30 September 2007.

BUDGET

Costs incurred by organizations outside Transport Canada will be borne by those organizations.

ADMINISTRATIVE SUPPORT

The General Aviation branch will be responsible for providing meeting facilities and secretarial support.

Accepted by:

_____	_____
Working Group Leader	Date
Unmanned Air Vehicle Working Group	

Approved by:

_____	_____
Manzur Huq	Date
Director, General Aviation	

_____	_____
Don Sherritt	Date
Director, Standards	

_____	_____
Martin Eley	Date
Director, Aircraft Certification	