National Defence Défense nationale

Canadian Forces College

Collège des Forces Canadiennes

PROPOSED CHANGES TO CANADIAN ARMED FORCES UNMANNED AIRCRAFT SYSTEM REGULATIONS

Major Geneviève Vallières

JCSP 46

Service Paper

Disclaimer

Opinions expressed remain those of the author and do not represent Department of National Defence or Canadian Forces policy. This paper may not be used without written permission.

PCEMI 46

Étude militaire

Avertissement

Les opinons exprimées n'engagent que leurs auteurs et ne reflètent aucunement des politiques du Ministère de la Défense nationale ou des Forces canadiennes. Ce papier ne peut être reproduit sans autorisation écrite.

Canada

CANADIAN FORCES COLLEGE – COLLÈGE DES FORCES CANADIENNES

JCSP 46 – PCEMI 46
2019 – 2020

SERVICE PAPER - ÉTUDE MILITAIRE

PROPOSED CHANGES TO CANADIAN ARMED FORCES UNMANNED AIRCRAFT SYSTEM REGULATIONS

Major Geneviève Vallières

Word Count: 2,196

Nombre de mots : 2.196

PROPOSED CHANGES TO CANADIAN ARMED FORCES UNMANNED AIRCRAFT SYSTEM REGULATIONS

AIM

1. This service paper will demonstrate that the current Canadian Armed Forces (CAF) Unmanned Aircraft System (UAS) regulations are overly restrictive. They should be modified to take into account the various levels of risk associated with UAS platforms. A framework will be presented in this paper to divide UASs into low and high risk platforms that would be managed respectively by the operator and by the Royal Canadian Air Force (RCAF) under different set of regulations.

INTRODUCTION

2. When the September 11, 2001 attacks occurred, the U.S. Army was operating approximately 30 UAS. Nine years later, they were operating over 2000 of them in both Afghanistan and Iraq. The low cost, reduced risk and practicality of the platforms had turned them into weapons of choice.[1] The number of UAS platforms has grown considerably since, and so have their capabilities and the range of missions for which they are suitable. The United States Department of Defense estimates that the services currently use over 11,000 UAS, ranging from the small RQ-11B Raven to the 32,000 lb RQ-4 Global Hawk.[2]

3. What is a UAS? It is a system comprised of an unmanned air vehicle, a ground station, and the equipment and personnel required to operate it. Other terms that are

[1] R.K. Barnhart *et al, Introduction to Unmanned Aircraft Systems* (Boca Raton: CRC Press, 2012), 15.
[2] United States Department of Defense, "Unmanned Aircraft Systems (UAS) – DoD Purpose and Operational Use," accessed 23 October 2019, https://dod.defense.gov/UAS/#targetText=UNMANNED%20AIRCRAFT%20SYSTEMS%20(UAS),and%20military%20training%20and%20exercises.

synonymous or encompassed by UAS include drones, Unmanned Aerial Vehicle (UAV) and Remote Piloted Aircraft System (RPAS).

4. Advancements in technology have created an explosion in the field of UAS in the past few years. Besides the military applications, UAS are used extensively commercially and by amateurs. Many small, cheap, and highly automated platforms have hit the market. These commercial platforms have also been attractive to military forces for missions such as reconnaissance.

5. Unfortunately, the CAF UAS regulations have not evolved with the technology. The CAF policy, as explained in CANFORGEN 220/15 is extremely restrictive and not based on sound risk analysis. This service paper will demonstrate that the current CAF UAS regulations are overly restrictive. The regulations should be modified to take into account the various levels of risk associated with UAS platforms.

6. First, this paper will argue that the CAF regulations are not in line with the UAS rules adopted by Transport Canada in the Canadian Aviation Regulations (CAR).[3] Then, the paper will explain how the over-restrictive CAF regulations hinder the flexibility of military UAS operators. Third, the paper will show how some UAS operations can be assessed as low risk and do not need over-regulation. Finally, the paper will propose a framework to divide UASs into low and high risk platforms, which would be managed respectively by the operator and by the RCAF under different sets of regulations.

DISCUSSION

[3] Canadian Aviation Regulation, SOR/96-433, Part IX (2019).

7. Transport Canada published the CAR part IX, which regulates the civilian use of UAS in Canada on 9 January 2019. These regulations recognize different levels of UAS operations:

a. Up to 250 grams: no requirement to register the device or to obtain a pilot certificate.

b. From 250 grams to 25 kg: the drone must be registered and the operator must possess a valid drone pilot certificate.

c. Above 25 kg, to operate beyond line of sight or for other operations not covered by the basic rules, the operator needs to obtain a Special Operations Flight Certificate.[4]

8. Unlike the approach adopted by Transport Canada, the CAF has not identified different levels of UAS operations in its policy. On the contrary, CANFORGEN 220/15 insists that "all UAS are considered as aircraft and their use by the CAF anywhere in the world is governed by [the Aeronautics Act] and [the National Defence Flying Orders]."[5] This means that a number of policies apply to UAS of all types and sizes, such as Flight Safety, for example. The Flight Safety Manual specifies that "every unit with a UAS capability shall implement a FSP [Flight Safety Program] commensurate with the scope

[4] Canadian Aviation Regulation, SOR/96-433, Part IX (2019).
[5] Department of National Defence, *CANFORGEN 022/15* (Ottawa: DND Canada, 2015).

of UA activities of the unit,"[6] without specifying what a commensurate program should encompass.

9. 1 Canadian Air Division's (1 CAD) Flight Operation Manual (FOM) does differentiate between categories of UAS using the NATO Classes. NATO Class I UAS are those weighing less than 150 kg, Class II weigh between 150 kg and 600 kg, and Class III weigh above 600 kg and are used beyond line of sight. Even though the FOM applies to all UAS air operations, it is more restrictive for Class II and III UAS.[7] Similarly, 1 CAD Orders acknowledge that Class 1 UAVs can be operated by trades other than pilots and without a full aircrew medical (although there are still extra medical requirements for Class 1 UAS pilots).[8] There is, therefore, an acknowledgment at the operational level that not all UAS should be regulated the same, but that logic has not been pushed to the same conclusion as it has been by Transport Canada.

10. This application of the same policy and regulations to all UAS in the CAF is hindering the flexibility of CAF UAS operators. The Royal Canadian Navy (RCN), the Canadian Army (CA) and the Special Operations Forces (SOF) are all operators of UAS. No local purchase is authorized for the procurement of UAS, no matter the size or cost, and all these systems need to follow the onerous Release to Service (RTS) process detailed in Air Force Order 8001-2.[9] Most of the RCN, CA and SOF systems are small and would fall under Transport Canada's less than 25 kg category if they were operated by civilians, and therefore would be subjected to a much simpler regulation framework.

---

[6] Department of National Defence, A-GA-135-001/AA-001, *Flight Safety for the Canadian Armed Forces* (Ottawa: DND Canada, 2018), 1-4/11.
[7] Department of National Defence, *Flight Operations Manual* (Ottawa: DND Canada, 2019).
[8] Department of National Defence, *Canadian Air Division Orders* (Ottawa: DND Canada, n.d.), vol. 3.
[9] Department of National Defence, *CANFORGEN 022/15* (Ottawa: DND Canada, 2015).

11. The RCN, for example, announced in 2018 the acquisition of the AeroVironment Puma II UAS,[10] which has a maximum take-off weight of 5.9 kg. Under the Transport Canada rules, these UAS would need to be registered, and the operators would require a basic drone pilot certificate, which only requires an online test. Under the DND rules, the units will need to stand up a Flight Safety Program, follow the Aeronautics Act and follow the National Defence Flying Orders. Before the RTS for this system gets approved, the Commander of the RCAF must grant Airworthiness Clearance based on the Technical Airworthiness Clearance granted by the Director General Aerospace Engineering and Program Management, and the Operational Airworthiness Clearance granted by the Commander of 1 CAD.[11] This would be required *no matter the size or cost* of the system.

12. This highly restrictive approach privileged by the CAF is not conductive to flexibility for UAS operating units. The level of effort required, especially for smaller, cheaper systems, is out of proportion with the cost and risk associated with the systems. The amount of regulations and the level of approval required are not conductive to the Army, RCN or SOF purchasing and employing small, low-cost, off-the-shelf systems.

13. Of course, one could argue that UAS are not risk-free systems. A 2001 study of US Military UAS operations found the rate of accidents was 10 to 100 times that observed in manned aircraft, and that operator error accounted for approximately 20% of

[10] AeroVironment, "Royal Canadian Navy to Field AeroVironment Puma II AE with Mantis i45 Sensor Aboard Coastal Defence Vessels," accessed 23 October 2019, https://www.avinc.com/resources/press-releases/view/royal-canadian-navy-to-field-aerovironment-puma-ii-ae-with-mantis-i45-senso.
[11] Department of National Defence, *Air Force Order 8001-2: Release to Service – New and Modified Aircraft Fleet* (Ottawa: DND Canada, 2010).

accidents.[12] Some risks are specific to UAS, such as the limited perception of the operator, the varying levels of automation and the lag if the vehicle is being controlled beyond line of sight.[13] On the other hand, many factors contributed to these extremely high accident rates in the early days of military UAS operations: many systems were still at the prototype stage when they were operationally deployed, most were not equipped with redundant systems, some were not using aircraft-quality parts, personnel lacked experience, logistics and maintenance were challenging, and they operated in battlefield environments.[14] There has been a steady improvement since 2001, and many systems are now approaching accidents levels seen in manned aircraft.[15]

14. Even if the probability of UAS accidents is higher than that for manned aircraft, there are some inherent characteristics of UAS that reduce the severity of the consequences, and hence the overall level of risk. First, UAS do not carry people, so the probability and severity of injuries or fatalities after an accident is greatly reduced. A UAS only poses risk to people on the ground and, in the event of a mid-air collision, a risk to people in the other aircraft. A look at the ground impact fatalities for manned aircraft shows that the chance of someone on the ground being killed in a crash is extremely low (10^{-8} h^{-1}) compared to the total number of aircraft accidents (10^{-5} h^{-1}).[16]

15. Another characteristic of UAS that has a big influence on the severity of the risk is their size. UAS have a huge range of takeoff weight, from a few grams to 12,000 kg (in

[12] R.K. Barnhart *et al, Introduction to Unmanned Aircraft Systems* (Boca Raton: CRC Press, 2012), 166.
[13] Konstantinos Dalamagkidis, Kimon P. Valavanis, and Les A. Piegl, *On Integrating Unmanned Aircraft Systems into the National Airspace System* (Dortrecht, Heidelberg, London, New York: Springer, 2012), 164.
[14] Ibid., 181.
[15] Ibid., 179.
[16] Ibid., 99.

2012), with the majority in the lower part of that range. Manned aircraft, in comparison vary from 100 kg (ultralight) to 600,000 kg (Airbus 380). Furthermore, the weight of UAS relative to equivalent manned aircraft is expected to go down in the future, due to miniaturization and improvements to structures and propulsion systems.[17] Dalamagkidis et al. describe a model that takes into account the weight of the system to classify its level of risk,[18] but it is intuitively obvious that the chances of causing death or injury in case of an accident increases with the weight of the system.

16. Other factors also play a role in evaluating the risks of UAS: the system can be sacrificed, if need be, to avoid injuries; bigger UAS can be equipped with collision avoidance systems; automated UAS can be programmed with protection mechanisms; etc. The point is that the overall level of risk associated with UAS, especially small ones, is quite low, and using a regulatory framework intended for manned aircraft is overly conservative and overly restrictive.

17. As a final point, it is simple to define a framework to separate CAF UAS in two categories for management purposes. The higher risk category would be managed by the RCAF, under the full spectrum of regulations currently in place. The lower risk category would be managed by the operating organization (CA, RCN, SOF or RCAF, as applicable) under a more permissive regulatory framework similar to that used by Transport Canada.

---

[17] Grzegorz Polak, "Operational and Technical Directions for Unmanned Aircraft Systems Development," *Security and Defence Quarterly* 18, no. 1 (2018): 63.
[18] Konstantinos Dalamagkidis, Kimon P. Valavanis, and Les A. Piegl, *On Integrating Unmanned Aircraft Systems into the National Airspace System* (Dortrecht, Heidelberg, London, New York: Springer, 2012), 92-115.

18. The first category would be higher-risk UAS. As explained above, higher weight would be the first characteristic that would create higher risk. To remain conservative, the discriminating weight category should be in line with the one defined by Transport Canada at 25 kg.

19. A second category of UAS operations that would be considered higher risk has to do with airspace. For systems requiring operations in Class A (above 18,000 ft) and Class B (above 12,500 ft, generally around major airports) airspace, there is a requirement for specific equipment and Instrument Flight Rules clearance that require more training on the part of the operators. These requirements would make systems operating in Class A and B airspace higher risk from an operational perspective and make the RCAF the logical choice for their management. An example of such a system would be the Northrop Grumman Global Hawk, which operates around 60,000 ft.

20. The final category that should be considered higher risk is armed UAS. When the system can be used to deliberately kill people, it automatically becomes a higher risk. The key feature of a UAS, from a law of armed conflicts perspective, is not the fact that it is unmanned, but the types of weapons that the UAS carry.[19] In other words, a UAS that carries missiles and bombs like a manned aircraft should be treated and managed in the same manner as a manned aircraft.

21. Therefore, UAS that weight over 25 kg, operate in Class A and B airspace or carry weapons should be considered high risk and managed by the RCAF in the manner

[19] Lydia de Beer, *Unmanned Aircraft Systems (Drones) and Law* (Nijmegen: Wolf Legal Publishers, 2011), 8.

described in CANFORGEN 220/15. All other UAS should be managed under the Transport Canada regulations, or an equivalent CAF-developed regulatory framework and no extra requirement should be imposed on the operators by the CAF.

CONCLUSION

22. This paper has demonstrated that the current CAF UAS regulations are overly restrictive, and should be modified to account the varying levels of risk associated with UAS platforms. This was done by comparing CAF regulations with the recently-adopted Transport Canada UAS regulations and by explaining how these over-restrictive regulations hinder the flexibility of operators. The paper then looked at the risk levels of UAS operations and proposed a framework to separate the systems into risk categories.

23. UAS operations are expected to grow substantially in the future, and a reasonable regulatory framework would allow the CAF to manage the risk without compromising safety or hindering the flexibility of the operators. This would be a step in the right direction for exploiting the capabilities of these platforms while maintaining an acceptable level of safety.

RECOMMENDATION

24. It is recommended that a two-tier UAS regulatory framework be implemented. High-risk platforms, weighing over 25 kg, operating in Class A and B airspace and carrying armament, would be managed by the RCAF under the existing CAF regulations. Low-risk platforms, which consist of all that do not meet the high-risk definition above,

would be managed by the operators, using the Transport Canada UAS regulations or an equivalent CAF-developed regulatory framework.

BIBLIOGRAPHY

AeroVironment. "Royal Canadian Navy to Field AeroVironment Puma II AE with Mantis i45 Sensor Aboard Coastal Defence Vessels." Accessed 23 October 2019. https://www.avinc.com/resources/press-releases/view/royal-canadian-navy-to-field-aerovironment-puma-ii-ae-with-mantis-i45-senso.

Barnhart, R.K., S.B. Hottman, D.M. Marshall, and E. Shappee. *Introduction to Unmanned Aircraft Systems.* Boca Raton: CRC Press, 2012.

Canada. Department of National Defence. A-GA-135-001/AA-001, *Flight Safety for the Canadian Armed Forces.* Ottawa: DND Canada, 2018.

Canada. Department of National Defence. *Air Force Order 8001-2: Release to Service – New and Modified Aircraft Fleet.* Ottawa: DND Canada, 2010.

Canada. Department of National Defence. *Canadian Air Division Orders.* Ottawa: DND Canada, n.d.

Canada. Department of National Defence. *CANFORGEN 022/15.* Ottawa: National Defence, 2015.

Canada. Department of National Defence. *Flight Operations Manual.* Ottawa: DND Canada, 2019.

Dalamagkidis, Konstantinos, Kimon P. Valavanis, and Les A. Piegl. *On Integrating Unmanned Aircraft Systems into the National Airspace System*. Dortrecht, Heidelberg, London, New York: Springer, 2012.

de Beer, Lydia. *Unmanned Aircraft Systems (Drones) and Law*. Nijmegen: Wolf Legal Publishers, 2011.

Polak, Grzegorz. "Operational and Technical Directions for Unmanned Aircraft Systems Development." *Security and Defence Quarterly* 18, no. 1 (2018): 57-75.

United States Department of Defense. "Unmanned Aircraft Systems (UAS) – DoD Purpose and Operational Use." Accessed 23 October 2019. https://dod.defense.gov/UAS/#targetText=UNMANNED%20AIRCRAFT%20SYSTEMS%20(UAS),and%20military%20training%20and%20exercises.