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SINGLE LINK KILL-CHAIN: ARMING THE AURORA OVER LAND

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AIM

1. The aim of this paper is to recommend that a feasibility study be conducted to explore the possibility of arming the CP-140 Aurora with air-to-ground precision guided munitions. This option will provide the Government of Canada with a flexible multi-role aircraft that can sense and act overland in support of international objectives.

INTRODUCTION

2. The CP-140 Aurora is in the final stages of an extensive modernization of its mission suite through the Aurora Incremental Modernization Program (AIMP), and structural upgrades that will see its service life extended to 2030 and beyond. In its final block of upgrades, the aircraft will be fitted with a state of the art sensor suite and mission system that will permit its use as a long range/long endurance intelligence, surveillance, and reconnaissance (ISR) platform in a congested and contested environment.

3. In the last ten years, with the addition of modern sensors, the Aurora has seen a shift from its traditional maritime anti-submarine warfare (ASW) and anti-surface warfare (ASuW) role to include an overland role. It has been employed successfully in the overland intelligence, surveillance, and reconnaissance (ISR) role during Op Mobile in Libya, and is currently deployed on Op Impact in Iraq and Syria. The aircrew is now familiar with the land environment and contributes significantly in the ISR domain in the fight against ISIS. The Aurora is designed to carry armament and the next logical step in its evolving role would be to explore an expanded use to carry a kinetic overland weapon. This paper will explore how an armed Aurora in the overland role would benefit the Government of Canada, and why it should be considered a high

priority to amend the Canadian Armed Forces (CAF) investment plan to add an air-to-ground precision guided munition (PGM) to the Aurora.

DISCUSSION

4. In the Canada First Defense Strategy (CFDS) one of the guiding principles is that Canada must be prepared to contribute to international peace and security. In that role the CAF are expected to be able to respond to the Government of Canada and provide combat-ready forces capable to conduct full-spectrum operations. Specifically, the CFDS states that “in concert with its allies, Canada must be prepared to act and provide appropriate resources in support of national interests and international objectives.”¹ The Royal Canadian Air Force (RCAF) further interprets this directive in its capstone document, *Air Force Vectors* (AFV). AFV defines core roles that are expected to be fulfilled by the RCAF with four basic vectors: Agile, Integrated, Reach, and Power (AIRPOWER). In the *Power* vector, the AFV states that “the Air Force must be adept at creating or contributing the desired power in both physical and moral domains via capabilities such as precision weaponry, stealth and maneuverability.”² As such there is a requirement for the RCAF to be able to deliver precision weapons on the battlefield. Currently, the only aircraft able to fulfil that role overland is the CF-188. This significantly limits the options available to the CAF to respond to the demands of the Government of Canada to act from the air in support of national objectives. AFV also state that “the Air Force will continue to pursue the operational advantages and cost efficiencies afforded by multi-role platforms, crews,

¹ Department of National Defence, *Canada First Defence Strategy* (Ottawa: Public Works and Government Services Canada, 2008), 9, accessed 29 January 2016, http://www.forces.gc.ca/assets/FORCES_Internet/docs/en/about/CFDS-SDCD-eng.pdf.

² Department of National Defence, *Air Force Vectors* (Ottawa: Director General Air Force Development, 2014), 41.

and weapons.”³ The Aurora is already an acknowledged contributor to projecting power in the counter sea role with its anti-submarine weapon, and it is a logical extension to explore the act capabilities it could add to the RCAF in the counter land core role.

5. The CP-140 Aurora was acquired in the early 1980’s as an armed maritime aircraft mainly geared towards the ASW and anti-surface warfare ASuW roles in support of the Royal Canadian Navy. With upgrades to its sensor suite, it has now migrated to being a multi-role, long-range patrol (LRP) aircraft capable of operating in all environments. It is presently the only dedicated airborne ISR asset available to the CAF.⁴ To ensure that the aircraft will remain relevant in the modern battlespace, it has undergone a series of upgrades under AIMP in successive blocks of equipment improvement. With Block I and II completed, the Block III configuration of the aircraft has provided the most important update, modernizing the entire mission system suite. In this configuration, the Aurora already has modern surveillance equipment including an MX-20 electro-optical/infra-red camera, an advanced imaging radar capable of mapping the ground through clouds, an electronic support measure system capable of intercepting emission from a broad spectrum of platforms such as radars and surface-to-air missiles, and the most advanced underwater acoustic system currently available. The last block of AIMP, Block IV, has been approved by the treasury board and by 2020 will see the addition of a self-defense system, a LINK-16 datalink, and a beyond line of sight high-bandwidth satellite communication system able to transmit near-real time imagery and over-the-horizon communication. In parallel with AIMP, the CP-140 is undergoing a structural life extension program that will prolong the life of a total of 14 aircraft to 2030 and possibly further.

³ Ibid.

⁴Department of National Defence, *Intelligence Surveillance and Reconnaissance (ISR) Directive – Spiral one*, (Winnipeg: 1 Canadian Air Division, 2016).

6. The Aurora crew is a multi-role tactically minded team that can easily adapt to new situations as seen by how well it has adopted the overland role. In its traditional ASW role, the crew is already capable of delivering a torpedo within strict attack criteria, and in the ASuW role it can provide targeting information to a missile-capable platform such as the Canadian Patrol Frigate (CPF), taking into account various conditions and restrictions. The crew understands the limitations and tactical, operational, and strategic implications of using lethal force. Since the aircraft is equipped with multiple sensors, the Aurora crew can “optimize, cross-cue, corroborate and fuse available sensor data in real-time ... into information that can be autonomously prosecuted.”⁵ The Aurora maintenance crew is trained and proficient in handling live armament with the mindset of safety and efficiency in loading an aircraft with explosive ordonnance.

7. The Aurora was designed to carry armament. The airframe is based on the U.S. P-3 Orion, and it possesses a bomb bay capable of carrying a maximum of 4,800 pounds.⁶ The aircraft was also designed to be equipped with underwing pylons that can carry armament. These pylons were provided with the Aurora on initial delivery, but they have never been installed. The Aurora aircraft operating instructions (AOI) state that the bomb-bay can be used to carry and deploy up to eight Mk82 (500 lbs) bombs, or three Mk83 (1000 lbs) bombs in various configurations.⁷ Although the Aurora has never carried bombs, the aircraft operationally carries up to eight Mk46 Mod 5A(SW) torpedoes in the bomb-bay which provides the crews a lethal option in the ASW environment. For comparison, along with the aforementioned torpedoes and Mk family of bombs, the U.S. P-3 is capable of carrying the Harpoon anti-ship missile and the

⁵ Department of National Defence, *Intelligence Surveillance and Reconnaissance (ISR) Directive – Spiral one*, (Winnipeg: 1 Canadian Air Division, 2016).

⁶ Department of National Defence, C-12-140-000-MB-002, *Aircraft Operating Instructions – CP-140 Aurora*, 1-76-14.

⁷ *Ibid.*, table 4-76-1.

SLAM-ER air-to-ground missile on its underwing pylons. The P-3 routinely carries the Harpoon missile and it used the SLAM for the first time in NATO's Op Allied Force in Kosovo in 1999. The P-3/CP-140 platform in general is therefore quite capable of delivering a variety of weapons both over water and over land.

8. Current precision guided munitions (PGM) weapons used in the air-to-ground environment that could be fitted to the Aurora can be broadly divided in two categories based on their guidance method: laser-guided or GPS-guided. To minimize costs, the U.S. has developed guidance kits that can be attached to conventional bombs to transform dumb-bombs, such as the Mk family of bombs, into precision munition. The kit usually consists of steerable aerodynamic fins attached to the aft portion of the bomb, and a guidance system either laser homing, or GPS/inertial guided. For example, the GBU-12 is a variant of the Mk82 bomb with the addition of winglets and a Paveway II laser computer control group.⁸ Similarly, the joint direct attack munition (JDAM) family of weapons consists of the addition of steerable tail fins, mid-body mounted winglets and a GPS/inertial guidance module to direct the descent of the bomb towards its target.⁹ Because these systems are based on existing bombs, the mounting points do not need to be modified on aircraft in current inventory. Both types of weapons typically require an inertial system input and/or a GPS input from the launch platform prior to being released. The JDAM and GBU obtain initializing data from the aircraft using an umbilical interface through a Mil-Std-1553 databus.¹⁰ The JDAM GPS interface derives its solution from the data available from the aircraft systems through the same means.¹¹ The CP-140 is equipped with a Mil-Std

⁸ Carlos Kopp, "JDAM Matures," *Australian Aviation*, 2003, accessed 29 January 2016, <http://www.ausairpower.net/TE-JDAMPt1.html>.

⁹ Ibid.

¹⁰ Ibid.

¹¹ Ibid.

1553 digital databus that can be adapted to interface with modern weapons. Additionally, it is equipped with dual integrated inertial navigation systems comprised of ring-laser gyros and global positioning system inputs that provide a precise digital position signal that can be extracted for tactical uses and gyroscope initialization. To independently use a laser-guided weapon, the delivering aircraft must be equipped with a laser designator. Although the version of the MX-20 camera installed in the Aurora does not possess a laser designator, there is a version that is equipped with one that could be retrofitted if a self-lasing capability was desired.

9. The advantage of the engagement of a target on the ground from an air platform is the rapidity with which the transition can be successful from first identifying a target to killing it with a weapon. This concept, called the kill-chain, usually consists of the find, fix, track, target, engage, and assess phases.¹² The efficiency of the process to get the information from the sensor to the shooter will often determine if the loop can result in a successful kill or a missed opportunity. Many steps must be taken to achieve a successful kill, and each link of the chain requires extensive coordination between multiple assets. By reducing the amount of players involved in the kill-chain, the likelihood of a broken link can be reduced significantly. The Aurora has been used extensively in the find, fix, track, and assess role in its new overland environment. Because the aircraft can remain airborne for up to 12 hours, it can loiter in an area to allow the crew to gain a thorough understanding of the situation on the ground. It can then identify targets, confidently discriminating between opposing forces and non-combatants. During the Libya campaign forays into the targeting role have been made by embarking a strike and armed reconnaissance coordinator (SCAR-C) on board the Aurora and directing strike aircraft to

¹² Andy Oppenheimer, "Find Fix Track Target Engage – Compressing the Kill Chain," *Military Technology*, 28 August 2013, accessed 29 January 2016, <http://www.miltechmag.com/2013/08/find-fix-track-target-engage.html>.

engage the identified targets.¹³ This required the controller to verbally cue the pilot of the strike aircraft onto the target so that he could in turn identify it to a level of confidence required to drop a weapon.

10. This is a perfect example of where an armed Aurora would have been more efficient. By having a weapon ready to be used by the sensing platform, the need to relay information to the shooter is eliminated since the sensor is the shooter. The time required to request the support of a strike asset to attack a target is also eliminated since the sense platform is ready to act if the situation evolves. This concept of arming the sensor is not new; the U.S. Air Force has been employing the Predator and Reaper unmanned aerial vehicles (UAV) in this manner in the uncontested skies over Iraq and Afghanistan for more than ten years. The Reaper UAV can carry four 500 lbs bombs on its underwing pylons, which gives the supported commander the option to react rapidly to a dynamic and evolving situation on the ground with lethal force.¹⁴

11. The armed Aurora can be integrated in the overland battlespace along the same lines as the armed UAVs, but it has several advantages over its unmanned counterpart. First, the UAV relies heavily on its satellite uplink to achieve its mission. In a contested environment, the satellite communications system will undoubtedly be one of the first victims of the modern battle. The Aurora being a manned platform does not require this wideband satellite link to conduct its mission. Secondly, the UAV is also difficult to integrate in the airspace, often being completely unable to operate in the civilian airspace structure. Over the battlefield, the UAV is

¹³ Alan Lockerby, "SCAR-C over Libya – To War in an Aurora", *Canadian Military Journal*, Vol 12, number 3, Summer 2012, accessed 29 January 2016, <http://www.journal.forces.gc.ca/vol12/no3/doc/PDFeng/Lockerby%20Page6367.pdf>.

¹⁴ David B. Hume, Colonel, USAF, *Integration of Weaponized Unmanned Aircraft into the Air-to-Ground System*, Air War College Maxwell, Paper No. 41, (Alabama: Air University Press Maxwell Air Force Base, September 2007), 3, accessed 29 January 2016, <http://www.au.af.mil/au/awc/awcgate/maxwell/mp41.pdf>.

usually constrained to a restricted operating zone (ROZ) which limits its flexibility and hinders other assets from operating freely.¹⁵ The Aurora is more adaptable since the pilots can ensure de-confliction with other assets and can conform to normal airspace rules and regulations allowing it to operate worldwide, in civilian and military controlled airspace. Finally, the UAV is often constrained by the weather in which it can operate and is frequently limited to good weather only. The Aurora is an all-weather platform that can operate in adverse weather with the flexibility of the pilots having a 360 degree view of the environment allowing the aircraft to remain tactically relevant when the weather deteriorates.

12. The risks to implement this project lie mainly in the extensive technical and operational airworthiness process that will have to be followed. This will include live weapon testing, aircraft weapon separation testing, and possible aircraft modifications along with aircrew training. The difficulties that can be encountered during this process can be mitigated by leveraging the experience of allies that have already utilized PGMs with their P-3 platform. The aircrew training can be mostly simulator based since a new simulator for the modernized CP-140 has recently been delivered to 14 Wing in Greenwood, Nova Scotia.

CONCLUSION

13. The modernized CP-140 has proven itself to be a robust and effective ISR platform in the overland role. Its crews are proficient in employing a weapon in the ASW and ASuW role and they have developed effective tactics techniques and procedures in the overland ISR role. The CP-140 is already technically capable of carrying bombs in its bomb-bay, even though this has

¹⁵Thierry Gongora, "The Relevance of Manned Fixed-Wing Aircraft in the Provision of ISR and C2 Support," *The Royal Canadian Air Force Journal*, Vol 2, no. 1 (Winter 2013), accessed 29 January 2016 http://airforceapp.forces.gc.ca/CFAWC/eLibrary/Journal/2013-Vol2/Iss1-Winter/Sections/07-The_Relevance_of_Manned_Fixed-Wing_Aircraft_in_the_Provision_of_ISR_and_C2_Support_e.pdf.

not been exercised in the past. Variations of the same types of bombs can be modified to become PGMs which require data input that is available on the CP-140. Since the RCAF AFV identifies a need to act by providing power via precision weaponry, it is logical to explore how existing assets can be added to the options available to deliver PGMs. The CP-140 is technically capable, its crews are tactically minded, and the weapon system already operates in an environment where PGMs are routinely used. The CP-140 is therefore the ideal candidate to be armed with PGMs in the overland role.

RECOMMENDATION

14. It is recommended that a feasibility study be conducted to explore the possibility of arming the modernized CP-140 Aurora with air-to-ground precision guided munitions. If this option is technically and fiscally feasible, the CAF investment plan should be amended to add PGM air-to-ground weapon to the Aurora arsenal as a high priority.

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