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REQUIREMENT FOR ROYAL CANADIAN NAVY ENHANCED UNMANNED AERIAL SYSTEM

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AIM

1. The intent of this service paper is to outline the requirement for an enhanced ship-borne Royal Canadian Navy (RCN) unmanned aerial system (UAS).[1] The objective is to explain how the RCN's use of UAS is currently limited and outline how the system capabilities of an enhanced UAS would benefit the RCN. This examination will not result in the prescription of any particular commercial-off-the-shelf (COTS) or military-off-the-shelf (MOTS) platform currently available.

INTRODUCTION

2. During OP ARTEMIS, Her Majesty's Canadian (HMC) Ships have been enthusiastic users of unmanned systems in support of maritime interdiction operations (MIO). Systems such as the Canadian Army-operated Boeing Insitu CU-169 SCAN EAGLE Unmanned Aerial Vehicle (UAV) have provided maritime forces with extended-range Intelligence, Surveillance and Reconnaissance (ISR) that has greatly contributed to the efficiency of deployed ships.[2] However, the RCN's use of this system has been limited by availability, employment and technology.

3. This service paper will address the current RCN capability gap and the expanded use for and requirements of a future, enhanced UAS. Future RCN UAS requirements must encompass effects beyond that of maritime interdiction as currently seen on OP ARTEMIS. This includes RCN roles and responsibilities as outlined in the Canada First

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[1] An unmanned aerial system has components which include the unmanned aerial vehicle (UAV), the supporting network and all the equipment and personnel necessary to control the UAV. From Royal Canadian Navy, *Concept for Maritime Unmanned Systems (MUS)* (Ottawa: Director General Naval Force Development, November 2015), 4.

[2] *Ibid*.

Defence Strategy (CFDS), the role of ISR in creating the effects demanded by the CFDS roles and responsibilities, and the associated requirements of future UAS in meeting these obligations.

DISCUSSION

4. During OP ARTEMIS, the HALIFAX Class utilized the CU-169 SCAN EAGLE UAS with great effect, conducting MIO in the Arabian Sea. However, the RCN has had to rely on other elements of the Canadian Armed Forces (CAF), mainly the Canadian Army (Artillery), to provide this capability on an *ad hoc* basis subject to system availability. As a result, use of embarked UAS has been limited to expeditionary operations. While the SCAN EAGLE performed exceptionally in its ISR role in support of MIO, its expanded use in other mission areas is limited by the technological attributes of this platform. A further examination of future UAS capabilities to meet a wider range of CFDS-mandated missions is therefore required.

RCN ISR Roles in CFDS

5. ISR has a key role to play in fulfilling the RCN's responsibilities in support of the CFDS. This role includes "providing surveillance of Canadian territory and air and maritime approaches," search and rescue, full-spectrum operations in support of international peace and security, and assistance to civil powers (e.g. major terrorist events, natural disasters).[3] Within the RCN framework of core competencies, ISR enables the "fight" function, or knowing "what is going on in real time and being able to act with a wide range of force options."[4] Thus, ISR has a major part to play in supporting the

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[3] Department of National Defence. *Canada First Defence Strategy* (Ottawa: Department of National Defence, 2008), 7-10.

[4] Royal Canadian Navy, *Leadmark: The Navy's Strategy for 2020* (Ottawa: Directorate of Maritime Strategy, 2001), 20.

RCN's military, constabulary and diplomatic roles. In support of maritime situational awareness, ISR support has grown in the last decade to include the *ad hoc* embarkation of an organic UAS for CJOC expeditionary operations (CU-169 SCAN EAGLE UAS).

Capabilities and Limitations of Current UAS

Capabilities

6. The use of UAS is a critical enabler to maritime operations as UAS can operate independently of the operational and safety confines that restrict manned aircraft such as the CH-124 SEA KING or CP-140 Block III AURORA. UAS typically have vastly greater loiter times and can fly into hazardous areas without risk to crew. Their low profile and quiet propulsion enables covert observation at greater ranges thus reducing risk to associated platforms and personnel. In addition, over-the-horizon (OTH) ISR contributes to the Common Operating Picture (COP) which enables commanders to make decisions that minimize "undesired effects of targeting through the best use of available resources."[5] Finally, UAS are significantly less expensive than manned ISR platforms. The current cost of the CU-169 SCAN EAGLE system is approximately $3.2 million (USD) which includes 4 unmanned aerial vehicles (UAVs) with the associated remote video terminal, launch system and recovery system.[6] This cost does not include manufacturer in-service support or training.

Limitations

7. Current embarked UAS have limited potential platform employment. For example, the SCAN EAGLE's line-of-sight (LOS) communications may preclude their use in supporting the targeting (identification, collateral damage estimation (CDE) and

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[5] Royal Canadian Navy, *Concept for Maritime Unmanned Systems (MUS)*, 8.
[6] United States Air Force, "Fact Sheet: Scan Eagle," last modified 15 September 2011, www.af.mil.

level 1battle damage assessment [BDA]) of littoral targets for the RGM-84L HARPOON Block II anti-ship missile; the missile range (approximately 150nm) far exceeds that of the LOS control of the SCAN EAGLE (approximately 60nm).[7] Secondly, the current platform is limited by its sensor load of electro-optical (EO) and/or infrared (IR). While EO/IR is useful for the positive identification of a target in daylight/nighttime conditions, it is not all-weather capable. The SCAN EAGLE is suitable for operations in the Caribbean (OP CARIBBE) or the Arabian Sea (OP ARTEMIS) where fair weather is likely; it is not suitable for operations along Canada's coastline or NATO operations in northern Europe where there are more adverse meteorological, oceanographic and climatic conditions. Finally, the RCN's current employment of UAS does not fully exploit the emerging allied Joint ISR (JISR) community of interest. While the CAF is a member of NATO ISR initiatives such as the Multi-Sensor Aerospace-Ground Joint ISR Interoperability Coalition (MAJIIC), collaborative employment and use of interoperable ISR is mainly confined to "theatre-level" ISR assets, such as the CP-140 AURORA BLOCK III.[8] The SCAN EAGLE is capable of being used both as a ship's organic sensor and in tandem with other ISR assets, but its employment within the RCN thus far has been limited to the non-networked finding and tracking surface targets based on cueing from other intelligence reporting.

Future UAS Employment

8. Future UAS employment must take into account the full spectrum of CFDS roles undertaken by current and future RCN surface platforms. Expanded use for an enhanced UAS capability in domestic maritime operations will augment effectiveness in

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[7] *Ibid*.

[8] Lars Neese, *Multi-Sensor Aerospace-Ground Joint ISR Interoperability Coalition*, (The Hague: NC3A, October 2006).

sovereignty patrols, fisheries patrols, ice monitoring/reporting in the Arctic and sub-Arctic regions, search and rescue along Canada's littorals, support to civil authorities in the event of natural disasters and in support of environmental protection. Expanded use for an enhanced UAS capability in expeditionary operations will include roles in enabling the littoral targeting function with the procurement of the RGM-84L HARPOON Block II, maritime interdiction (counter-narcotics, counter-terrorism, counter-piracy), and ISR in maritime chokepoints. The use of an enhanced UAS capability will therefore deliver a greater number of effects in support of the CFDS by increasing the number and variety of ISR missions undertaken.[9]

Future RCN UAS Requirements

9. In order to achieve optimal effect for both domestic and expeditionary operations, future RCN UAS must meet a number of operational requirements and technological criteria.

Environmental Considerations

10. In order to provide enhanced ISR coverage of Canada's vast coastline and economic exclusion zone (EEZ), including maritime approaches to Canadian ports, future RCN UAS must be able to operate from HMC Ships in a wide variance of hostile meteorological, oceanographic and climatic conditions encompassing all Canadian oceans.[10] This may range from all-weather SAR operations in Arctic conditions to heavy sea states throughout the Canadian EEZ. In addition, future RCN UAS must be able to continue to provide ISR support to expeditionary maritime operations throughout environmentally challenging regions in such places as the Indian Ocean and Arabian Sea.

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[9] Royal Canadian Navy, *Concept for Maritime Unmanned Systems (MUS)*, 2.
[10] *Ibid*., 5.

This means that both the platform and the sensor must be able to launch, operate, and be recovered in a wide array of challenging environmental conditions day or night.

Platform Requirements

11. In addition to being rugged enough to operate in extreme environmental conditions, LOS communications for current UAS will be a significant factor restricting their use in a targeting role. With a communications range of approximately 60nm, using a UAS for reconnaissance of potential targets, target folder development, positive identification (PID) for CDE or Level 1 BDA would put HMC ships within the Missile Engagement Zone (MEZ) of many littoral coastal defence cruise missile (CDCM) batteries. It is therefore essential that future UAS utilize beyond line-of-sight (BLOS) satellite relay or third party tactical control (other ISR or C_2 platforms) to significantly extend the range of the UAV. This would enable future RCN UAS to be utilized in support of the targeting cycle for either the employment of the RGM-84L HARPOON Block II in a land-attack role against littoral targets or as a third party targeting (TPT) ISR platform for other RCN and/or allied weapons systems.

Sensor Requirements

12. Current ship-borne UAS utilize EO/IR sensors that limit the range of missions that can be undertaken. When operating in the Canadian area of responsibility (AOR), this presents significant challenges due to the prevalence of adverse weather conditions. As both environmental conditions and missions vary by geography, it is therefore necessary to have a tailorable, mission-dependent sensor mix. This would include EO/IR, synthetic aperture radar (SAR) movement track indicator (MTI) on-board processing capability and an onboard electronic support measures suite (ESM). The inclusion of

SAR-MTI will enable HMC ships to conduct UAS operations with cloud cover over the target area, be less susceptible to visual spoofing (use of decoys), onboard cross-cueing of targets and redundant coverage in the event the Canadian Space Agency (CSA) RADARSAT Constellation Mission (RCM) is unable to provide or disseminate SAR data to HMC ships given other Government of Canada priorities or platform revisit times.[11] An onboard ESM collection capability would provide a level of redundancy and fidelity to both embarked ESM capabilities aboard HMC ships and overhead ESM coverage.

UAS Architecture Requirements

13. Future RCN UAS platform and sensor performance will have the desired effect only if adequate systems architecture is in place to support it. The UAS must be considered both a ship's organic sensor while at the same time being part of a larger "system of systems" at a national and allied level. It is critical that the information collected by the UAS be processed, exploited, disseminated (PED) and integrated into the COP to enhance the commander's situational awareness. This would entail ensuring that personnel such as the Naval Electronic Sensor Operators (NESOPs) or the Embarked Intelligence Team (EIT) have first line PED analysis training to be able to interpret the incoming real-time images.

14. It is also important that the ISR data collected be disseminated throughout the allied community for further processing, analysis and reporting as part of a "systems of systems" approach to ISR collection, exploitation and processing. It is therefore critical that UAS ISR data be available via a networked community that would include CAF, Five Eyes (FIVEY) and NATO partners in accordance with CAF Joint Intelligence

[11] Marc Boucher, "The Defence and Security Applications of the RADARSAT Constellation Mission," last modified 19 March 2013, http://spaceref.ca/space-quarterly/the-defence-and-security-applications-of-the-radarsat-constellation-mission.html.

doctrine.[12] ISR data dissemination must also take into account emerging NATO MAGIIC and JISR project procedures that include the use of linked and interoperable collection management and mission planning systems, Coalition Shared Databases (CSDs), and NATO standardization agreement (STANAGS)-compliant full-motion video (FMV) data, storage, archival and retrieval (DSAR) technology.[13] This will allow for the cooperative and coordinated sharing and fusion of UAS-collected data; it will decrease the requirement for redundant collection while pooling increasingly scarce and valuable PED resources. NATO is developing the JISR capability mentioned above through Allied Command Transformation (ACT) initiatives such as MAGIIC, the UNIFIED VISION ISR trial series and the ISR Collection Management Tool (ICMT).[14] Coordination between NATO and CAF in this matter is currently being led by Chief of Force Development (CFD). However, current RCN UAS data is neither integrated into the COP nor provided via allied networks for greater collaboration. Current practices for UAS PED beyond afloat analysis are confined to a developing capability within the Maritime Component Command (MCC) Maritime Intelligence Support Team (MIST). Through the Multi-Year Establishment Plan (MYEP), limited positions have been authorized to augment the afloat analytical PED capability although this support infrastructure must develop and formalize as future RCN UAS capabilities increase.

15. Cross-cueing architecture must also be considered for future RCN UAS operations. This entails overhead, air, surface and subsurface corroboration of data from a mix of sensors to provide a more comprehensive multi-source ISR picture. For example,

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[12] Department of National Defence, B-GL-005-200/FP-001, *Canadian Forces Joint Publication 2-0: Intelligence* (Ottawa: DND Canada, October 2011), 3-10

[13] Matthew J. Martin, "Unifying Our Vision: Joint ISR Coordination and the NATO Joint ISR Initiative" *Joint Force Quarterly* 72, no.1 (2014): 55-57.

[14] *Ibid*.

should an overhead or fixed wing coalition ISR aircraft collect electronic intelligence (ELINT) indicating an active SA-6 associated STRAIGHT FLUSH radar along a hostile coastline, an embarked UAS could be cross-cued via datalink (subject to established tasking priorities) to PID the presence of the co-located SA-6 transporter-erector-launcher (TEL) using its EO sensor. This represents a time-critical, flexible, low-risk, cost effective response in support of time-sensitive targeting that enables low-risk, stand-off strike. Domestically, cross-cueing would be advantageous in providing: persistent coverage of a search area in support of SAR, in tandem with emergency response or RCAF SAR assets; ISR support to other government departments (in support of major events); or overhead RCM cueing for ice warning in support of Arctic navigation.

Training and Development

16. To adequately support future UAS capabilities, the RCN must invest in UAS training and development for UAS operators, maintainers and analysts. This includes individual training such as UAS pilot training in accordance with NATO Class I UAS requirements, technician training for airframe maintenance and EO, IR, and SAR-MTI sensor imagery analysis training.[15] However, this also includes collective training such as integrating this capability into the ship's organic sensors as part of collective training and greater intelligence analytical training pertaining to collection management.

17. While maritime UAS operations are not new to the RCN, the capabilities presented above demand further Canadian Armed Forces Maritime Warfare Centre (CFMWC) conceptual development. BLOS UAS employment in the maritime environment using a myriad of tailorable sensors in support of expanded domestic and

[15] North Atlantic Treaty Organization, ATP 3.3.7. *Guidance for the Training of Unmanned Aircraft Systems (UAS) Operators*, edition B, version 1 (Brussels: NATO Standardization Agency, April 2014): 1-4, 1-5.

expeditionary ISR missions will require fundamental tactics, techniques and procedure (TTP) review as this new capability is integrated into shipboard sensors, CJOC ISR operations and the NATO JISR community.

CONCLUSION

18. Current RCN utilization of the Canadian Army CU-169 SCAN EAGLE has had tremendous effect during MIO in the Arabian Sea. However, its use is subject to availability, its employment limited based on weather conditions and lack of networked connectivity to the greater ISR community. An enhanced UAS with BLOS communications, a tailorable sensor mix and networked PED architecture to other CAF, FIVEY and NATO elements would dramatically increase the effect of maritime UAS collection while reducing the RCN resources needed to process, exploit and disseminate collected data. While a future RCN UAS capability would require investment in individual and collective training and infrastructure, the returns would be a cost effective, low-risk, flexible ISR response that enables RCN ISR roles in support of the CFDS.

RECOMMENDATION

19. Given the myriad of possible RCN missions and the limited nature of the CU-169 SCAN EAGLE, it is recommended that an enhanced RCN UAS capability be examined to include increased platform and tailorable sensor capabilities that enable greater employment. In addition, it is recommended that any future RCN UAS capability include and a robust, integrated cross-domain “systems of systems” ISR architecture to enable timely and responsive collaboration in support of CAF and Allied maritime operations.

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