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LESS SEARCH, MORE RESCUE: REGIONALLY OPTIMIZED CAPABILITIES

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JCSP 42

Service Paper

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PCEMI 42

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CANADIAN FORCES COLLEGE – COLLÈGE DES FORCES CANADIENNES
JCSP 42 – PCEMI 42
2015 – 2016

JCSP SERVICE PAPER – PCEMI ÉTUDE MILITAIRE

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Word Count: 2441

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AIM

1. The aim of this paper is to inform the 1 Canadian Air Division Commander of current and pending advancements that impact effective and efficient delivery of search and rescue (SAR) services. New technology is taking the *search* out of search and rescue, while the need for rescue remains constant. This paper illustrates how regional optimization and ratios of fixed wing (FW) and rotary wing (RW) SAR resources would serve the Royal Canadian Air Force's (RCAF) vision of an integrated and multirole¹ airpower capability fulfilling Canada's domestic and international SAR obligations through delivery of required effects² to achieve mission success.

INTRODUCTION

2. The Canadian Armed Forces' (CAF) primary responsibility for the provision of aeronautical SAR services arises from Canada's status as a signatory State to the international agreements of the Convention on International Civil Aviation Organization and the Convention for the Safety of Life at Sea. In 1947 a Cabinet Directive assigned responsibility for the provision of aeronautical SAR services to the RCAF.³ To continue to meet this responsibility, RCAF doctrine currently considers SAR as a Core Air Mobility capability.⁴ Air Force Vectors places both SAR and surveillance in the strategic context of defending Canada⁵ while the SAR mission itself is considered personnel recovery.⁶ Notwithstanding that the correct FW platform has the

¹ Department of National Defence, A-GA-007-000/AF-008, *Air Force Vectors* (Ottawa: Director General Air Force Development, 2014), 41.

² *Ibid.*, 42.

³ Department of National Defence, B-GA-209-001/FP-001, *Canadian Aeronautical and Maritime Search and Rescue Manual* (Ottawa: DND, 2014), 1.06.1, 1.07.2, 1.06.9.

⁴ Department of National Defence, B-GA-400-000/FP-000, *Canadian Armed Forces Air Doctrine* (Ottawa: Commander of the Royal Canadian Air Force, October 2015), Draft 5-2.

⁵ National Defence, *Air Force Vectors* ..., 12.

⁶ National Defence, *Air Force Vectors* ..., 28; National Defence, *Canadian Armed Forces Air Doctrine* ..., 5-2.

benefit of speed and endurance, only a RW capability provides the essential recovery effect. The cost of aircraft platforms and mission suites is driving the necessity of multirole platform capabilities,⁷ so optimization is increasingly relevant.

3. Canada's SAR area of responsibility is defined under the above agreements and encompasses over 18 million square kilometres of land and sea.⁸ It is innately obvious that this size results in challenges of climate, geography, distance and demographics which require different resource capabilities in order to resolve every possible distress situation. An analysis based on a combination of empirical⁹ evidence, technological advances and a particular region will illustrate optimization possibilities. Specifically, the Victoria Search and Rescue Region (SRR) with its diverse geography, distribution of SAR cases, adaptation to current and future technologies for employment of multirole aircraft, and historical tasking ratios will be used to support the concept of a regionally optimized capability and ratio. Additionally, a United States Coast Guard (USCG) example will be provided for comparison. Finally, a statistical RW and FW resource tasking history for the Trenton and Halifax SRRs will be tabled to show that the optimization concept could be expanded to these SRRs.

DISCUSSION

Geography

4. SRR Victoria has rugged terrain – 1,427,000 square kilometers of mainly mountainous topography and 687,000 square kilometers of the Pacific Ocean, extending to 600 nautical miles off Canada's west coast.¹⁰ The mountainous terrain is ideally suited to helicopter SAR operations

⁷ Defence Today, "Air combat platforms and ISR," *Defence Today* (March 2009): 44, <http://www.ousairpower.net/SP/DT-Deptula-March-2009.pdf>.

⁸ National Defence, "Search and Rescue in Canada," Last modified 26 November 2014, <http://www.forces.gc.ca/en/operations-canada-north-america-current/sar-canada.page>.

⁹ National Defence, *Air Force Vectors* ..., 41. Notes requirement to adapt, based upon empirical study.

¹⁰ National Defence, "Victoria Search and Rescue Region," Last modified 19 August 2015, <http://www.forces.gc.ca/en/operations-canada-north-america-current/victoria-sar.page>.

due to the inherent manoeuvrability of a RW platform. Likewise, due to the size of the offshore and littoral regions, the RCAF RW CH149 Cormorant is the only platform with the capability to affect all weather, day or night, multi-person search *and* rescue in a perilous, life threatening maritime scenario.

Statistical Distribution of SAR Cases

5. A Defence Research and Development Canada study of the Victoria SRR indicates that the historical distribution of aeronautical and maritime SAR distress and potential distress cases occur within 300 miles¹¹ of 19 Wing Comox. This distance is often within two hours flying time of the Cormorant. Adding to the ease of reach by the multirole search *or* rescue Cormorant, this area is entirely comprised of the mountainous and maritime environments, where, as noted, only a rescue *effect* will ultimately resolve the SAR case. Though there is high population density in the southwestern part of British Columbia, the remainder of the 300 mile radius is remote, with limited roads and often only air or water access.

6. In response to the Office of the Auditor General's report that was critical of the RCAF's SAR posture,¹² trials were conducted in an effort to align 30 minute response times with the statistically highest likelihood of SAR cases.¹³ However, SAR cases can occur 24/7, and arguably those SAR cases that lie outside the statistical bell curve are equally life threatening. If the ratio of RW assets were to be increased, along with crewing aspects, the 442 SAR Squadron Cormorant could posture to react on 30 minutes notice 24/7. Not only would this match the SAR

¹¹ Defence Research and Development Canada. *DRDC-RDDC-2015-L096, Review of 2008-2014 Joint Task Force Pacific Joint Rescue Coordination Centre Search and Rescue demand and 2014 posture change* (Victoria: DRDC Canada, 2015), 6-7.

¹² Office of the Auditor General, *Report of the Auditor General of Canada, Federal Search and Rescue Activities* (Ottawa: Auditor General of Canada, 2013), 30.

¹³ National Defence, "Search and Rescue Posture Review 2013," Last modified 23 May 2014. <http://www.forces.gc.ca/en/about-reports-pubs/search-and-rescue-posture-review.page>.

case geographic distribution, but a FW aircraft on two hour response would eventually rendezvous with the Cormorant during those infrequent geographically distant cases.

Current and Future Technology

RW Technology

7. The current ratios were established when the RW rescue platform was the CH113 Labrador helicopter. The Labrador had speed, altitude, automation and in-flight icing condition limitations. These drawbacks resulted in operations designed to accommodate the platform's flight envelope. For example, the FW platform flew ahead to locate the search object, because the Labrador's slow transit speed resulted in minimal time on-scene. The limited automation on the Labrador required other assistance, either in the form of flare illumination or even navigation information. Finally, the in-flight icing restriction meant that the Labrador might not be able to respond at all. The Cormorant overcomes all these limitations, so there is a diminished need for FW resources. Additionally, the Aerospace Engineering Test Establishment has tested a new service ceiling for the Cormorant, which would remove the current 10,000 foot altitude restriction and allow the Cormorant to fly direct to destinations within mountainous regions.

8. The pararescue construct originated with W.R. "Wop" May, a famous Canadian bush pilot, who, in the mid-forties organized his own civilian parachute rescue agency modelled after the United States Forestry Service's smoke jumpers.¹⁴ Near the same timeframe, the first ever helicopter rescue took place in 1945, using a Sikorsky S-51¹⁵ - the same model Canada acquired in 1947.¹⁶ There has been a natural evolution in ratios since the acquisition of this first

¹⁴ John Melady, *Heartbreak and Heroism: Canadian Search and Rescue Stories* (Toronto: Dundurn Press, 1997), 3-5.

¹⁵ Sikorsky History, "Civilian Rescue: First Helicopter Civilian Rescue, November 29, 1945," http://www.sikorskyarchives.com/Civilian_Rescue.php.

¹⁶ G.Y. Smith, *Seek and Save: The History of 103 Rescue Unit* (Erin: The Boston Mills Press, 1990), 20.

helicopter. With the confluence of rapidly advancing distress locating technology, coupled with advanced RW platform technology, a ratio adjustment is the logical next step.

Multirole Sensors

9. For the few searches that do occur over the ocean, the upgraded Intelligence, Surveillance and Reconnaissance (ISR) sensor suite on the CP140 Aurora¹⁷ would bring a technological enhancement over the current employment of a strictly visual search, providing a new search dimension and adding to the overall detection capability.¹⁸ Further, the Aurora's speed and endurance would allow the overwater search area to be conducted more rapidly – a critical aspect given that overwater searches constantly expand due to drift forces. Consequently, this increasing size results in expending more search hours than would otherwise be necessary to cover the search area.¹⁹ This is not a revolutionary concept; it has other precedent. The United Kingdom Ministry of Defence used the Nimrod (their Intelligence, Surveillance, Targeting Acquisition, Reconnaissance aircraft²⁰) for the overwater SAR role²¹ until the aircraft's retirement in 2010.

10. Inland areas realize less benefit from electronic sensor detection due to tall trees, and other obscuring features. Further, though winter land survival is precarious, it is arguably not as precarious as water survival. In Victoria, a relatively warm region of Canada, survival time

¹⁷ Royal Canadian Air Force, "Canada's modernized CP-140 Aurora has 'James Bond' properties," Last modified 20 May 2014, <http://www.rcaf-arc.forces.gc.ca/en/article-template-standard.page?doc=canada-s-modernized-cp-140-aurora-has-james-bond-properties/hvexurr>. Four aircraft are not currently budgeted to undergo this upgrade.

¹⁸ National Defence, *Canadian Aeronautical and Maritime Search and Rescue* ..., 4.08.10, 4.08.15, 5.01.8.

¹⁹ National Defence, *Canadian Aeronautical and Maritime Search and Rescue* ..., 4.05.9 – 4.08.9. Chapter provides explanation of factors and considerations used to determine an over-water search area.

²⁰ Ministry of Defence, Royal Air Force, "AGILE ADAPTABLE CAPABLE Nimrod MR2," Last accessed 31 January 2016, <http://www.raf.mod.uk/history/nimrodmr2.cfm>.

²¹ Ministry of Defence, *Military Search and Rescue Annual Statistics 2014* (London: MOD, 2015), 53.

ranges between two to eight hours.²² It is therefore essential to have both the speed and sensors to locate a maritime search object quickly and vector in the capability that can effect the rescue.

Regulatory Enactment

11. Transport Canada is finally amending Canadian Aviation Regulations to require the internationally accepted digital 406 MHz emergency locator transmitter (ELT) technology to be carried on board all aircraft. Further, there will be monetary penalties for false alarms caused by owner negligence.²³ This pending mandatory requirement will further decrease the need for a search capability as these new distress beacons generally have positional information digitally encoded and allow rescue capability to proceed directly to the transmitted location vice homing a radio frequency to the distress location. Though there is a chance that an ELT may be damaged on impact, a RW capability, with its slower search speed, is better suited to sleuth a weak transmission source. Additionally, a new satellite constellation will eliminate orbital delays of analogue signal monitoring that were inherent in the legacy satellite monitoring system.

New SAR Satellites

12. “Beacons can take the ‘search’ out of search and rescue, and the MEOSAR [Medium Earth Orbit SAR Satellite] system will dramatically increase the global search-and-rescue capability,” said Maritime New Zealand Director Keith Manch.²⁴ MEOSAR is the next version of COSPAS-SARSAT, the international search-and-rescue satellite system. The current system of SAR beacon monitoring is made up of low earth orbiting (LEOSAR) and geostationary (GEOSAR) satellites. The GEOSAR system does not cover high-latitude (e.g., polar) regions, and relies upon digitally transmitted GPS data. The LEOSAR system is polar orbiting and does

²² Gordon Giesbrecht, “Cold Water Boot Camp,” http://www.coldwaterbootcamp.com/pages/1_10_60v2.html.

²³ Transport Canada. *Canadian Aviation Regulation Advisory Council, Notice of Proposed Amendment, #: 2015-013*, 1, 7.

²⁴ GPS World, “McMurdo Completes MEOSAR Ground Station in New Zealand,” Last modified 10 November 2015, <http://gpsworld.com/mcmurdo-completes-meosar-ground-station-in-new-zealand/>.

not need a digital GPS signal to determine a beacon's location. However, because of the constellation's low altitude orbit, satellite passes see less of the earth's surface, consequently taking longer for complete coverage. The MEOSAR system will provide real time worldwide coverage without either disadvantage: concurrent detection of a digital distress message and independent beacon location fix.²⁵ The MEOSAR solution, which completed the evaluation phase in 2015²⁶ and achieves initial operational capability in 2016,²⁷ will be a technological leap.

Unmanned Aerial Vehicles

13. In addition to the imminent increase in satellite coverage, unmanned aerial vehicles (UAVs) are poised to offer a tremendous search capability. In the fall of 2015, the United States Coast Guard (USCG) trialed a combined SAR helicopter and UAV exercise near Deadhorse, Alaska. The certified UAVs, which can operate from ship or shore, located the search object and passed the coordinates to the helicopters to effect the rescue. A retired USCG pilot noted, "They [UAVs] save us all kinds of time and money. I've been on search flights where you're out there for three or four bags of gas. If they can send a UAV that can be out there for hours and then tell us where to go, that's a moneymaker right there."²⁸

Historical Tasking Ratios

14. Data review of the Search and Rescue Mission Management System indicates that, over the period from 2010 to 2014, in the Victoria SRR, the Cormorant had, on average, twice as many missions as the FW CC115 Buffalo²⁹ even with an equivalent number of platforms.³⁰

²⁵ National Oceanic and Atmospheric Association, "SARSAT Future Enhancements Medium Earth Orbit Search and Rescue (MEOSAR) System," <http://www.sarsat.noaa.gov/future.html>.

²⁶ COSPAS-SARSAT International, International Satellite System for Search and Rescue, "MEOSAR," Last accessed 01 February 2016, <http://www.cospas-sarsat.int/en/2-uncategorised/177-meosar-system>.

²⁷ National Oceanic and Atmospheric Association, "SAR Controllers Training 2014," (March 2014): 14.

²⁸ Dan Megna, "The Future of SAR?" *Vertical*, 10 October 2015, <http://www.verticalmag.com/news/article/TheFutureofSAR>.

²⁹ Sarah Hughes, "CAF Taskings Request All Three JRCC Analysis," E-mail 27 January 2016. Analysis sourced from the SAR Mission Management System via Systeme d'Information SAR.

Additionally, detailed examination of 2014 data³¹ shows that many of the Buffalo's taskings were concurrent with the Cormorant's taskings. This, of course, is due to the fact that a FW can only search and ultimately a RW resource is concurrently required to accomplish the rescue. Additionally, almost one quarter of the Buffalo's taskings were for ELT false alarms. Once Transport Canada's new regulations come into force and the COSPAS-SARSAT MEOSAR system is operational, a further decrease in their SAR taskings will logically follow.

15. RW platforms have lower Instrument Flight Rules visibility limits. Additionally, for SAR operations, one-half miles flight visibility is permitted – a limit that is realized to its maximum benefit with a RW platform's variable speeds and manoeuvrability. Further, the RW can land at unlit facilities; a limitation of FW capabilities. Lower weather limits and unrestricted night operations make the RW platform an indispensable asset for SAR as it is able to respond to more taskings than a FW capability. The ability to adjust speed to weather and terrain makes it indispensable in mountainous terrain – where poor weather severely limits FW capability – no matter how manoeuvrable the platform. Given these advantages, helicopters not only have a better chance of reaching the distress site – but are able to complete the rescue once on scene.

USCG Comparison

16. The USCG District 17, Alaska, is a reasonable comparison to the Victoria SRR with respect to terrain, though it is larger, encompassing 3,853,500 square miles.³² By comparison, this district has a greater than 2:1 ratio of RW to FW platforms: employing six H-60 Jayhawk helicopters, four H-65 Dolphin helicopters and four C-130 Hercules aircraft. Three Jayhawks are

³⁰ Department of National Defence. *Federal Search and Rescue Operational Governance Committee Annual Report 2014*. (Canadian Joint Operations Command: file 3385-1, March 2015), 3-4.

³¹ Sarah Hughes, "Pacific Only 2014," E-mail 16 December 2016.

³² USCG Newsroom, "Coast Guard 17th District schedules change of command in Juneau, Alaska," 10 April 2014, <http://www.uscgnews.com/go/doc/4007/2142546/Coast-Guard-17th-District-schedules-change-of-command-in-Juneau-Alaska>.

stationed in Sitka, three are co-located with the four Hercules in Kodiak, Alaska and the Dolphins in Kodiak forward deploy onboard the USCG patrol cutters.³³

Canadian SRR Comparison

Halifax SRR

17. Although the three SRRs are different in size, all have an average of 3,000 SAR cases per year.³⁴ Halifax's SRR is 4.7 million square kilometres and has many similarities to the Victoria SRR in that it has a large over water responsibility and remote terrain. The Halifax region has two SAR squadrons which results in a total of seven Cormorants and three FW CC130 Hercules³⁵ aircraft. As would be expected, the tasking ratio of RW to FW is higher, almost 3:1.³⁶ This SRR sets a precedent for regional optimization of a RW to FW platform and capability ratio of 2:1 and can be used to consider similar optimization ratios in the other SRRs.

Trenton SRR

18. The Trenton SRR is the largest area at 10 million square kilometres, and includes the north as well as all of Canada's inner provinces. This region also has two SAR squadrons resulting in a total of eight Hercules and five RW CH146 Griffons.³⁷ Given the size of the region, having numerous FW assets makes intuitive sense; however, the tasking ratios are almost 1:1.³⁸ Though the Trenton SRR must maintain the Major Air Disaster Kit airlift capability, the fact that the tasking ratio is on par could indicate the need for more Griffon platforms. It could also indicate that there is statistical selection bias, whereby the Griffon is not tasked because it has less range and payload than the other primary SAR helicopter, the Cormorant.

³³ Elan Head, "SAR Alaska Style," *Vertical*, 11 April 2012, http://www.verticalmag.com/features/features_article/20240-sar-alaska-style.html.

³⁴ Sarah Hughes, "CAF Taskings Request All Three JRCC Analysis," E-mail 27 January 2016.

³⁵ National Defence. *Federal Search and Rescue Operational Governance Committee Annual Report ...*, 3-4.

³⁶ Hughes, "CAF Taskings Request All Three JRCC ...,"

³⁷ National Defence. *Federal Search and Rescue Operational Governance Committee Annual Report ...*, 3-4.

³⁸ Hughes, "CAF Taskings Request All Three JRCC ...,"

CONCLUSION

19. Each SRR faces particular challenges, and a one-size-fits-all approach is not practical. However, detailed examination of the Victoria SRR has illustrated how regional optimization could deliver the SAR mandate more effectively and efficiently. A broad overview of similarities and differences in other SRRs has been provided. The Trenton SRR would benefit from further study to determine optimal platform ratios. The Victoria and Halifax SRRs could benefit from the multirole FW effects of ISR and search and, as shown by the Halifax and USCG District 17 platform ratios, the Victoria SRR could particularly benefit from a RW to FW platform ratio of 2:1. This conclusion is drawn with current statistics, which don't yet reflect the pending technological changes.

20. Advances in technology (MEOSAR and UAVs), as well as regulatory implementation of technology (406 MHz ELTs), will only further decrease the requirement for the single role search effect. From a pure SAR perspective this would mean increasing the RW Cormorant platforms as the Cormorant provides the robust search and rescue effect. From a broader perspective, regional optimization could include reduced FW platforms undertaking the shrinking search role concurrent with another regionally required RCAF effect, such as ISR or transport.

RECOMMENDATION

21. Conduct a detailed review of the SRRs to ensure that all regions are optimized to nationally deliver the multirole search and rescue service that is aligned with the multirole, effects-based, construct of the RCAF's airpower vision.

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