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## AIR-TO-AIR REFUELLING: A CAPABILITY WORTH MODERNIZING

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## **AIR-TO-AIR REFUELLING: A CAPABILITY WORTH MODERNIZING**

### **AIM**

1. Despite a relatively small size in terms of crews and aircraft, Royal Canadian Air Force's (RCAF's) Air-to-Air refueling (AAR) capability is critical in effectively supporting domestic and expeditionary fighter activities. Canada's two AAR fleets, the CC-150T and CC-130T play critical and distinct roles in RCAF operations and are key enablers of all RCAF fighter activities, each in their own way. This writing shall argue that despite the fact that there is as yet no confirmed replacement for the CF18, Canada and the RCAF should actively investigate modernization or replacement of both current AAR platforms and not just the CC-150T to ensure relevance of the AAR capability and concurrently consider enhancing the AAR capability to new receiver aircraft.

### **INTRODUCTION**

2. AAR plays a critical role in both domestic and expeditionary RCAF operations and is a critical means by which RCAF fighter aircraft extend their reach both at home and abroad. As stated in the RCAF Capstone Doctrine "AAR is thus a force enabler, a force multiplier, or both,

depending on the mission being conducted.”<sup>1</sup> Historically the AAR capability has not garnered a significant amount of public attention in Canada from the public or Government despite the fact that it has become a ubiquitous contribution to NATO and coalition operations as has been the case recently with NATO Operation UNIFIED PROTECTOR in 2011 and ongoing support as part of Operation IMPACT where RCAF CC-150Ts have been deployed continuously since 2014 supporting coalition fighters in the fight against Daesh.

3. Canada’s current AAR fleet consists of two CC-150T Polaris tankers based at 8 Wing Trenton and four CC-130T Hercules tankers based at 17 Wing Winnipeg<sup>2</sup>. The Government of Canada’s current Defence policy; Strong, Secure and Engaged (SSE), makes only a single brief reference of an intent to “recapitalize” the CC-150 fleet but contains no other substantive intent or commentary on the AAR capability or of any ambition to modernize it<sup>3</sup>. Notwithstanding that initial staff efforts are underway to replace the CC-150T by 2026, in an effort to maintain, and potentially enhance, this critical capability RCAF efforts should be apportioned to identifying and procuring replacement AAR platforms in sufficient time to avoid any potential capability gap. It has been argued that the RCAF fighter replacement should be determined prior to initiating any in depth discussion on replace it AAR capability this is a false assumption. The majority of modern strategic AAR platforms are able to accommodate both boom and probe and drogue equipped aircraft and such flexibility will be a definite asset in any strategic AAR replacement. Such capability would be valuable not only for Canada’s own purposes in terms of

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<sup>1</sup> Department of National Defence. B-GA-400-000/FP-001, *Royal Canadian Air Force Doctrine* (Trenton : Canadian Forces Air Warfare Centre, November 2011), 35.

<sup>2</sup> There had originally been five CC-130Ts however one was destroyed by an in-flight fire during an exercise in Florida in 2012.

<sup>3</sup> Department of National Defence, *Strong, Secure, Engaged : Canada’s Defence Policy* (Ottawa: Canada Communication Group, 2017), 39.

accommodating a fighter replacement but would also make any so equipped strategic tanker replacement a more versatile coalition resource by being able to refuel both boom and probe and drogue receivers.

4. RCAF Move Doctrine subdivides AAR into strategic and tactical missions but does not subdivide platforms as strategic or tactical<sup>4</sup>. The CC-130T and CC-150T are each capable of strategic or tactical missions. In order to demonstrate the importance of the RCAF's AAR capability, AAR will first be described in the current domestic and expeditionary contexts after which will follow a brief summary of potential enhancements to the current capability that could be achieved relatively quickly through timely acquisition of multi role AAR platforms.

## **DISCUSSION**

5. Canada's expansive land mass, particularly in the Arctic where useable airfields are scarce, makes an AAR capability critical in order for RCAF CF-18s to be effective in their NORAD role. CF-18s configured for typical NORAD operations and operating from one of Canada's Forward Operating Locations (FOLs) has a very limited range and endurance to be able to reach much of the Arctic. The CC-130T has been Canada's most commonly employed AAR platform in supporting NORAD Northern Sovereignty Operations (NSO) owing to its ability to operate from shorter airfields than the CC-150T and thus operate from FOLs and alternate locations in the north as required by the tactical scenario. Limitations in some specific FOL facilities, most notably runway lengths have meant that the CC-150T has been unable to effectively support the bulk of NORAD operations from the most commonly used FOLs and has

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<sup>4</sup> Department of National Defence. B-GA-404-000/FP-001, *Canadian Forces Aerospace Move Doctrine* (Trenton : Canadian Forces Air Warfare Centre, November 2011), 31.

thus been of limited utility in northern deployed NORAD operations. The CC-130T's small fleet size and crew force are such the United States Air Force (USAF) is still heavily relied upon for AAR support in the deployment and redeploy phases of the majority of NORAD operations<sup>5</sup>. It is thus key to note with respect to current and future AAR capability that arctic infrastructure, specifically short runways and limited fuel supplies means that a relatively small, short field capable AAR capability is likely to remain essential in order to provide flexibility and reach to cover the whole of Canada's sovereign territory using organic RCAF AAR resources. Having CC-150T or similar large tankers operate from southern airfield such as Yellowknife mean that the tanker requires additional fuel for its own transit which limits offload available to receiver aircraft.

6. There are several other benefits to having a robust AAR capability in the domestic context that must also be recognized. AAR support is a significant enabler and force multiplier in moving CF-18s around the country for administrative and maintenance functions. The range of a CF-18 is such that movements between the RCAF's two CF-18 Main Operating Bases (MOBs) at Cold Lake Alberta and Bagotville Quebec require AAR support to reliably enable transit between the two without an intermediate fuel stop. Such intermediate stops add both time and increased risk of maintenance challenges and being able to eliminate them through AAR can thus have significant advantages<sup>6</sup>.

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<sup>5</sup> The specific details of USAF AAR support to NSO Operations are classified beyond this writing.

<sup>6</sup> Department of National Defence. B-GA-404-000/FP-001, Canadian Forces Aerospace Move Doctrine (Trenton : Canadian Forces Air Warfare Centre, November 2011), 31.

7. AAR support is similarly a key enabler to fighter Force Generation (FG) activities. During routine training having an AAR asset available allows the opportunity to hone AAR skills and allows for extended, more complex and realistic training scenarios. At the same time it has the added benefit of reducing landing cycles and risk of maintenance delays in much the same way as the cross country limitations previously discussed. In these scenarios either the CC-130T or CC-150T are valuable and employable with preference for long distance movements being the CC-150T whose higher speed and increased offload make it a more suitable platform for long range administrative movements.

8. It is evident from the above discussion that AAR is critical in current and future domestic fighter operations and indeed in enabling the development of the fighter capability through support to FG activities. It further illustrates the benefit and flexibility provided by maintaining a short field AAR fleet for northern operations as facilities can often not accommodate larger tankers.

9. In an expeditionary context AAR has proven indispensable in two key areas. First, AAR provides the reach to be able to deploy RCAF fighters overseas. Second, and arguably more importantly, AAR has proven to be a valuable contribution to NATO and coalition air campaigns. In the case of expeditionary activities the speed and fuel offload capability of the CC-150T make it the current AAR platform of choice and a similar speed and offload capacity will be required in order for RCAF fighters, regardless of the chosen CF-18 replacement, to have global reach thus to be capable of deploying using organic RCAF assets in support of SSE's objective of being engaged in the world. In the case of deployment and redeployment overseas,

AAR is a matter of absolute necessity given that the CF-18 and any potential replacement lack the fuel capacity to be able to conduct oceanic crossings without AAR support. Currently the CC-150T is the RCAF's preferred asset for accomplishing these tasks due to its higher speed and offload as discussed previously<sup>7</sup>. In determining any future AAR capability the ability to conduct these types of strategic movements would be at the core and of the utmost importance.

10. Having this oceanic capability readily available has become a challenge in recent years given Canada's enduring commitment of a CC-150T in support of OP IMPACT. Having one of the only two CC-150T's continuously deployed has meant that the second one aircraft is typically unavailable for domestic tasks as it is generally in contracted third line maintenance when not deployed. This has meant reduced flexibility on the part of CF-18 deployments to overseas operations and exercises. In a handful of cases the RCAF has needed to seek USAF and contracted AAR support at significant cost. This highlights the desirability of a modest increase in fleet size for any CC-150T replacement. The requirement for long range strategic AAR will not diminish in the future and so it is critical to maintain the capability but having more than two strategic tanker platforms to fulfill this critical role should be strongly considered.

11. In terms of support and contribution to expeditionary operations the value of RCAF AAR resources is evident in their employment both at OP IMPACT but also in support of OP UNIFIED PROTECTOR in 2011 where both CC-150T and CC-130T assets were deployed to provide fuel to RCAF and allied receiver aircraft. The value of AAR in such operations is immense as fighter aircraft seldom have the required range to be able to prosecute their missions

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<sup>7</sup> The CC-130T is capable to oceanic AAR but speed and offload limitations typically mean multiple crossings are required to move the same number of fighters as a CC-150T could move in a single crossing.



without AAR. AAR can not only extend range but also allow for increased weapons payloads, allow for increased on station time to conduct Combat Air Patrols (CAPs) or provide a contingency capability as a recovery tanker for carrier based aircraft or any aircraft that is returning to base low on fuel. In many instances participating allied nations either do not possess or cannot afford to deploy AAR assets and so contributing to a pool of AAR resources can be a high value proposition from both a military and political perspective. In particular it can allow Canada to contribute a high value asset to a coalition air operation that is non-kinetic and thus less likely to draw the ire of an opposition critic or other negative public opinion but still a tremendous enabler to coalition efforts.

12. The value of a capable high volume tanker in expeditionary operations is clear both in doctrine and in practice and any future AAR capability must be heavily focused towards this core capability. There are however many potential advantages to an expanded AAR capability that should be considered as part of any discussion regarding future RCAF AAR capability.

13. In considering a future AAR capability decision makers would be well served to look beyond the current limitations of RCAF doctrine which limits substantive discussion regarding helicopter refueling to helicopter in flight refueling (HIFR) from ships<sup>8</sup>. In a country as vast as Canada a case can easily be made for developing an AAR capability for either or both of the CH-149 Cormorant Search and Rescue (SAR) and CH-147 Chinook helicopter fleets. In much the same way that AAR extends the reach of fighters a tactical refueler akin to the CC-130T could conceivably allow SAR crews to respond much faster to distant locations and in particular those

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<sup>8</sup> Department of National Defence. B-GA-404-000/FP-001, *Canadian Forces Aerospace Move Doctrine* (Trenton : Canadian Forces Air Warfare Centre, November 2011), 30.

in the north<sup>9</sup>. Similarly but perhaps less probably, an AAR capability on the Chinook helicopter fleet would permit more rapid deployment of ground troops to the north either in support of Major SAR operations or in a more purely military capacity if required. Both of these potential future capabilities would rely on a slower tactical tanker and to be truly viable would require increased AAR crew force in order to maintain a stand by posture in the case of SAR. The fixed wing SAR replacement C-295 in fact has a nascent roll on roll off helicopter AAR capability that could potentially be investigated to enable a SAR AAR capability<sup>10</sup>.

14. While the adoption of helicopter AAR by a tactical tanker would require upgrades to the current helicopter fleets the CC-177 Globemaster is already equipped as an AAR receiver and use of a strategic tanker equipped with boom refueling could conceivably allow CC-177 operations to extend well beyond their current reach ultimately allowing more timely delivery of freight during contingency operations or merely accelerating deploy and redeploy timings and extending overall reach during routine and deliberate operations.

15. In further assessing any future capability it should be noted that the RCAF is not large enough to be able to justify a tanker specific fleet. Despite a clear utility, a dedicated AAR fleet would likely not have enough receiver traffic to be gainfully employed. As such any modernized AAR capability, strategic or tactical, should employ multi role air mobility platform(s) such that when not being employed in an AAR role the crew and aircraft can be employed in a traditional air mobility role augmenting movement of passengers and freight in support of other operations.

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<sup>9</sup> J.S.G. Lamarche, "The Backbone of Reach and Power: Air-to-Air Refueling in the RCAF" (Directed Research Project Paper, Canadian Forces College, 2015), 54.

<sup>10</sup> Jane's Online, "Airbus C295" last modified [or accessed] 03 February 2018, <https://janes.ihs.com/Janes/Display/jawa0984-jawa>.

Many modern AAR platforms, such as the Royal Air Force (RAF) A330 Voyager<sup>11</sup>, provide a lift capability even while conducting refueling operations. This would represent a substantial improvement over the current AAR capability and would allow more rapid deployment of fighter maintenance crews and support equipment concurrent with AAR operations whereas such transport must currently be provided by other transport aircraft.

## CONCLUSION

16. The current RCAF AAR capability is demonstrably critical to current RCAF fighter capability in both domestic and expeditionary roles. That said, it is a very limited capability that could be made more robust not only as a capability in itself but also in terms of the force multiplying effect that could potentially be brought to bear by considering a broader scope to AAR doctrine and capabilities within the RCAF. Additionally, AAR represents a valuable non-kinetic contribution to multinational operations. It is also critical to consider that barring sudden and dramatic increase in runway length at specific FOLs both a large strategic tanker fleet and a smaller tactical tanker fleet will be required in order to maintain the current level of capability and thus the full capability and not just the recapitalization of the CC-150T will be required. To that end it is important that the future of the capability be very carefully considered and steps taken to modernize both fleets before the capability languishes in terms of equipment and of expertise of existing AAR crews.

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<sup>11</sup> Jane's Online, "Airbus A330 Multirole Tanker Transport (MRTT)" last modified [or accessed] 03 February 2018, <https://janes.ihs.com/Janes/Display/jawa0429-jawa>.

## **RECOMMENDATION**

17. Rather than focus purely on replacement of the CC-150T the RCAF should examine its AAR capability holistically to include northern operations and the requirement for a modern tanker that offers the CC-130Ts capabilities. In so doing it should also consider the broadening of the AAR doctrine and capability to include helicopter refueling and strategic refueling of the CC-177 to capitalize on the full functionality and potential of any future AAR aircraft.

## BIBLIOGRAPHY

- Campbell E.D. “Air-to-Air Refuelling Operations in Canada’s North (Remote Areas)” (Canadian Forces Command Staff College Paper, Canadian Forces College), 1988.
- Canada. Department of National Defence. B-GA-400-000/FP-001, *Royal Canadian Air Force Doctrine*. Trenton: Canadian Forces Air Warfare Centre, November 2016.
- Canada. Department of National defence. B-GA-404-000/FP-001, *Canadian Forces Aerospace Move Doctrine*. Trenton: Canadian Forces Air Warfare Centre, November 2011.
- Canada. Department of National Defence. *Strong, Secure, Engaged : Canada’s Defence Policy*. Ottawa: Canada Communication Group, 2017.
- Dee, A.G.O. “Air-to-Air Refueling in the Canadian Forces Until 2010” (Canadian Forces Command Staff College Paper, Canadian Forces College), 1988.
- Jane's Online. "Airbus A330 Multirole Tanker Transport (MRTT)" last modified [or accessed] 03 February 2018. <https://janes.ihs.com/Janes/Display/jawa0429-jawa>.
- Jane’s Online. “Airbus C295” last modified [or accessed] 03 February 2018. <https://janes.ihs.com/Janes/Display/jawa0984-jawa>.
- Lamarche, J.S.G. “The Backbone of Reach and Power : Air-to-Air Refueling in the RCAF” (Directed Research Project Paper, Canadian Forces College), 2015.
- Tanner, R.M. *The History of Air-to-Air Refuelling*. South Yorkshire UK : Pen & Sword, 2006.