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STRATEGIC TANKER REPLACEMENT: THE FUTURE OF CANADA'S AIR-TO-AIR REFUELLING CAPABILITY

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AIM

1. With the CC-150T Polaris fleet coming to the end of its life, the 2017 defence policy, Strong, Secure, Engaged (SSE), includes an initiative to “[recapitalize the] next generation strategic air-to-air tanker-transport capability.”¹ In December 2020, the Department of National Defence moved the Strategic Tanker Transport Capability (STTC) project to the definition phase.² Before a request for proposal is issued, the Royal Canadian Air Force (RCAF) is interested in understanding how its air-to-air refuelling (AAR) capability will look like in the future, and understanding the operational and financial considerations associated with the STTC. This paper aims to define the factors the STTC project should consider, framed within the future concept of operations of the new fleet for operations at home and abroad, and recommend the number of aircraft that should be procured.

INTRODUCTION

2. AAR is crucial for sustained fighter operations, such as supporting the North American Aerospace Defense Command (NORAD) mission, projecting fighters abroad, and any expeditionary operations involving fighters. Without the support of AAR assets, a CF-188, for example, has enough fuel to stay airborne for only two and a half hours. When fighters are based away from enemy threats, far from the area of operations, fighters are incapable of any persistence without tankers. Additionally, without AAR support, crossing the Atlantic Ocean takes a CF-188 at least 48 hours and five refuelling stops, not taking into account weather or maintenance delays, which can be reasonably expected.³ With tanker support, the same voyage can take as little as eight hours.

3. Before a request for proposal can be issued, it is crucial to understand what is needed in terms of capability. This requires an understanding of how the AAR capability will be utilized in the strategic and tactical air-to-air refuelling missions. This understanding will drive the AAR requirements of the STTC projects and, ultimately, how many aircraft the RCAF needs.

¹ Department of National Defence, *Strong, Secure, Engaged: Canada’s Defence Policy* (Ottawa: 2017), 39.

² Government of Canada, “Strategic Tanker Transport Capability project,” last modified 18 December 2020, <https://www.canada.ca/en/department-national-defence/services/procurement/strategic-tanker-transport-capability-project.html>.

³ Route flown at 480 knots ground speed, from Bagotville, QC, to Trapani, Italy, going through Goose Bay, Greenland, Iceland, United Kingdom and Germany. This so-called North Route is generally victim of marginal weather such as high winds, low ceilings and airborne icing. During such a trip in 2014, the author experienced a 5-day delay because of high winds in Iceland.

DISCUSSION

4. While both the CC-130T and the CC-150T statements of operating intent refer to tactical and strategic air-to-air refuelling, the definitions associated with those terms cannot be found. For this paper, tactical AAR will be defined as “refuelling provided to receiver aircraft while in the performance of an actual ... combat mission in a tactical scenario.”⁴ Tactical AAR can be divided into NORAD operations and Force Employment. Strategic AAR will be analogous to force projecting of AAR receivers, such as CF-188s. Each role has its own unique set of requirements.

NORAD

5. SSE states the “Canadian Armed Forces will be prepared to ... meet its NORAD obligations....”⁵ NORAD is a critical mission for the RCAF, which relies on AAR and is, by nature, complex. Currently, for the initial deployment to a Forward Operating Location (FOL), the RCAF uses, through the NORAD agreement, United States AAR assets, and this concept is unlikely to change. As it stands, CC-130Ts from Winnipeg support continued operations in support of an active NORAD mission. In that capacity, a CC-130T is generally co-located with the fighters. The CC-130T fleet is currently scheduled to be retired in 2022, and the NORAD AAR role was assigned to the CC-150T fleet after it achieved final operational capability in late 2020.⁶ When brought into service, the future tanker will take that role over.

6. NORAD operations are often sudden and unexpected. Fighters and AAR assets hold an alert posture and, when activated, can be deployed for weeks on end at a FOL, supporting an active NORAD mission. Ideally, to improve coordination and response time, AAR assets supporting active NORAD missions should be collocated with the fighters they support. While it is understood that the next tanker may not be capable of operating from FOLs year-round and may have to operate from Deployed Operating Bases (DOB), it should be capable of operating from Inuvik’s future 9,000 feet long runway and new infrastructure when environmental conditions permit. The new tanker must be compatible with factors such as runway size, parking space available, the size of the airport’s manoeuvring areas, instrument approaches availability, and pavement classification number.⁷

⁴ Department of National Defence, *CC130H Hercules Statement of Operating Intent* (Ottawa: Canadian Air Force, 9 November 2009), 20.

⁵ Department of National Defence, *Strong, Secure, Engaged: Canada’s Defence Policy* (Ottawa: 2017), 81.

⁶ Skies Magazine, “Polaris aircrews certified for NORAD tanking task,” last accessed 2 February 2021, <https://skiesmag.com/news/polaris-aircrews-certified-norad-tanking-task/>.

⁷ Transport Canada defines pavement classification number as “a number expressing the bearing strength of a pavement for unrestricted operations.” When compared to the aircraft classification number or “the relative structural loading effect of an aircraft on different pavement types (flexible or rigid) for specified standard subgrade/bearing modulus values,” it determines the compatibility between a surface and an aircraft; Performance calculations should be computed using worst case conditions.

7. Data from the CF188 Data Management System show that active NORAD sorties can last up to eight and a half hours. As such, a single future tanker must be able to transit from a DOB or FOL to the operating area, provide 75,000 pounds of aviation jet fuel over six hours, and return to its origin with sufficient Instrument Flight Rules (IFR) reserve.⁸ Furthermore, the new tanker's time required for ground operations must be compatible with current NORAD postures.

Force Projection

8. For this paper, Force Projection means providing fuel during the transit to an operation. In the current RCAF's case, it means the support to fighter aircraft deployment overseas. Currently, the CC-150T is relatively limited in its capacity to provide AAR to deploying fighters. When deploying to Italy to participate in OP MOBILE, seven CF-188s were projected using two CC-150Ts. Despite being supported by two tankers, the fighters had to stop in the United Kingdom; the tankers could not provide enough fuel for the CF-188s to reach Italy. While on the surface, this seems acceptable, en route stops carry a risk of aircraft breakdowns, delaying the arrival in the theater. Furthermore, the movement of equipment and personnel of the fighter detachment was not immediate and required two CC-177s bringing the minimum equipment necessary to stand the fighter detachment up. Additionally, the fighter detachment was chronically short of weapons for the first 30 days, having no more than 24 hours worth of weapons most of the time.

9. Sometimes, the Government's desired strategic effect is to "[be] there immediately."⁹ Two of the next air-to-air refueler must be capable of force projecting six of the future fighter from Canadian Forces Base (CFB) Bagotville to the Middle East, along with 200 people, 11 cargo pallets, and a deployable sensitive compartmented information facility (SCIF). With weapons flown on a separate airlift platform, the CF-188 detachment could operate independently for one month.¹⁰ This would allow the RCAF to truly capitalize on airpower's speed and reach in support of the Government's objectives. Deploying personnel and equipment on the AAR aircraft would also provide independence and give time to the sustainment effort to start providing the necessary support without tying up precious cargo space on other strategic airlift platforms.

Force Employment

10. In the context of this paper, Force Employment is defined as the employment of AAR aircraft in support of allied receivers within a defined theater of operations. In

⁸ Fuel calculated using a fuel burn of 6,000 pounds per hours by two fighters, using the current NORAD alert configuration.

⁹ Paul Johnston et al, "A Canadian Approach to Command at the Operational Level," *Canadian Military Journal* 14, no. 4 (Autumn 2014): 10-11.

¹⁰ A typical fighter detachment consists of six CF-188 with 200 personnel and a Pack-Up Kit (PUK); A standardized CF-188 PUK consists of nine cargo pallets however, to sustain six aircraft conducting six sorties per day over a month, two additional pallets with spare parts and specialized equipment are needed.

general, “[as] a nation, Canada typically contributes forces to campaigns led by others.”¹¹ General Vance defined this concept as *contribution warfare*.¹² For Canada, the act of being there and being seen as participating is often *the* political effect the Government is looking for. Depending on the mission or the political risk a given government is willing to take, employing kinetic effects or having boots on the ground may not be politically palatable.

11. Canada has a history of providing non-kinetic support to allies. For example, Canada provided strategic airlift to support the French military forces deploying to Mali in 2013.¹³ Partners always welcome this form of support. Air-to-air refuelling is an area where Canada could be seen as contributing, with little physical or political risk while providing a much-needed capability in any operation involving airpower. Indeed, the North Atlantic Treaty Organization (NATO) is chronically short of AAR platforms.

12. While on paper, “NATO has sufficient numbers of tankers to meet its Level of Ambition ... this is only possible through heavy reliance on [United States] assets.”¹⁴ Seventeen NATO nations have air-to-air refuelling requirements, yet only nine have an AAR capability.¹⁵ AAR, being a critical and currently limited capability, is an area where Canada could be seen as a meaningful contribution to the alliance with little risk, akin to how the Canadian Armed Forces contributes strategic airlift to partners. Furthermore, this approach could reduce the burden the United States has to provide to the alliance, providing Canada some leverage over the United States.

Air-to-Air Refuelling System

13. Now that the mission requirements have been defined, determining what refuelling system the next tanker should have is essential. There are two types of refuelling systems: probe and drogue, and boom and receptacle. On the probe and drogue system, currently installed on CC-150Ts, the tanker portion consists of a refuelling hose with a drogue installed at its end attached to the tanker. The hose can be extended or retracted. After it is extended, the receiver maneuvers its probe into the drogue. Figure 1 depicts this system. Beyond extending and retracting the hose, and starting and stopping the fuel flow, the system does not require any inputs from the tanker. Most tankers fitted with this system can refuel two receivers simultaneously; however, some can only refuel one.

¹¹ Paul Johnston et al, “A Canadian Approach to Command at the Operational Level,” *Canadian Military Journal* 14, no. 4 (Autumn 2014): 10.

¹² Jonathan H. Vance, “Tactics without Strategy or Why the Canadian Forces Do Not Campaign,” in *The Operational Art: Canadian Perspectives Context and Concepts*, edited by Allan English et al (Kingston: Canadian Defence Academy Press, 2005), 280.

¹³ Editorial, “Canada sending C-17 transport plane to help allies in Mali,” *Canadian Broadcast Corporation News*, 14 January 2013.

¹⁴ Joint Air Power Competence Center, *Air-to-Air Refuelling Consolidation – An Update* (Kalkar, Germany: The Joint Air Power Competence Center, March 2014), 8.

¹⁵ *Ibid.*



Figure 1 – Probe and Drogue Air-to-Air Refuelling System

Source: Arthur Ark, Canadian Armed Forces photo.

14. The tanker portion of the boom and receptacle system consists of a telescopic tube with moveable flying surfaces. A receiver aircraft flies itself in a pre-determined position and opens its receptacle. Once the receiver is in a proper position, a boom operator inside the tanker aircraft flies the boom into the receiver's receptacle. Figure 2 depicts this system.



Figure 2 – Boom and receptacle Air-to-Air refuelling system

Source: Phil Speck, United States Air National Guard photo.

15. It is obvious the next strategic tanker will need to accommodate the future fighter. As it stands, of the remaining three future fighter contenders, two are compatible with the probe and drogue system, and one is compatible with the boom and receptacle system.¹⁶ Most strategic tankers available on the market offer a dual system option. Regardless of the choice of the future fighter, the probe and drogue system should be retained. The RCAF already has that capability; there is no requirement for additional training. The only incremental costs will be to account for an increase of personnel related to a

¹⁶ The F-35A Lightning II is fitted with a receptacle. The JAS 39 Gripen and the F/A-18E/F Super Hornet are fitted with a probe.

potential increase in the number of platforms. However, those costs would also materialize for the boom and receptacle system.

16. The more difficult choice is whether the boom and receptacle system should be acquired if the future fighter is equipped with a probe. By 2025, excluding the United States, of NATO's projected 98 tankers, only 32 will be fitted with a boom.¹⁷ This is a reduction of 12 percent from the 2014 inventory.¹⁸ Traditionally, European-made fighters are fitted with a probe. However, with the increased popularity of the F-35A, fitted with a receptacle, the demand for tankers equipped with a boom will increase. Italy and Norway decided to replace part of their fourth-generation fighter aircraft fleets, fitted with a probe, with the F-35A. Excluding the United States and taking into account the retirement and procurement of aircraft, NATO will increase its number of fighters equipped with a receptacle by 112 aircraft by the time all the current F-35A orders are fulfilled.¹⁹ The reduction in boom-equipped tankers, combined with the increased demand from receptacle-equipped fighters, puts NATO further at odds of meeting its AAR demand. Canada has the opportunity to provide a meaningful contribution to NATO by helping to fill the AAR capability gap. In the end, the RCAF should pursue a dual-system tanker, regardless of the selection of the future fighter. This approach will improve Canada's flexibility in delivering non-kinetic effects.

17. Introducing a boom and receptacle refuelling system would require training in a task the RCAF has never conducted: flying the boom and connecting it to a receiver. The United States Air Force employs In-Flight Refuelling Specialists, an enlisted occupation, as boom operators.²⁰ The RCAF does not have a non-commissioned member occupation that would fit a boom operator's roles and responsibilities. However, the Royal Australian Air Force (RAAF) employs Air Combat Officers, an occupation equivalent to the RCAF's Air Combat Systems Officer (ACSO) occupation, as boom operators.²¹ Given that RCAF ACSOs trained as Flight Refuelling Specialists (FRS) already coordinate and lead AAR missions, the training requirement should be minimal. A concept of operation similar to that of the RAAF could be duplicated for the future RCAF boom capability.

¹⁷ *Ibid*, 10, table 2; The European Defence Agency (EDA) AAR Initiative surpassed their objectives of providing 31 AAR platforms by 2025. The EAD AAR initiative procured 38 AAR platforms, but only nine are compatible with the boom and receptacle system.

¹⁸ Joint Air Power Competence Center, *Air-to-Air Refuelling Consolidation – An Update* (Kalkar, Germany: The Joint Air Power Competence Center, March 2014), 10, table 2.

¹⁹ Craig Hoyle, "The changing balance of NATO's European fighter fleet," *Flight Global*, 26 November 2020; Every country's replacement projects were analyzed. Before the entry in service of the F-35A, NATO had 512 receiver aircraft fitted with receptacles. With planned F-35A procurements and F-16s retirements taken into account, NATO will have 614 aircraft fitted with receptacles.

²⁰ United States Air Force, "Enlisted – In-Flight Refuelling Specialist," last accessed 7 January 2021, <https://www.airforce.com/careers/detail/in-flight-refuelling-specialist>.

²¹ Royal Australian Air Force, "Air Force Officer – Full Time – Mission Aircrew," last accessed 7 January 2021, <https://airforce.defencejobs.gov.au/jobs/mission-aircrew-air-combat-officer>.

Number

18. Now that the basic requirements and the future concept of operations of the next tanker have been addressed, it is essential to discuss the number of STTC aircraft the RCAF should procure, beyond what is required to maintain a routine NORAD posture. Canada deployed tankers for operations only three times: one during OP FRICTION, three during OP MOBILE, and two during OP IMPACT.²² Canada should procure at least two aircraft for the Force Employment mission. The same two aircraft could be used for the Force Projection mission, allowing for six CF-188 and their air detachment to deploy simultaneously with the future tanker.

19. The STTC aircraft will also serve in the strategic airlift and Very Important Person transport roles. All STTC aircraft should be configured the same to increase flexibility and efficiency. During a deployment, fighters sometimes have to be replaced with aircraft from Canada, requiring trans-oceanic transit support. Instead of using a deployed asset, as is sometimes the case, one of the aircraft assigned to the strategic airlift mission could be used for this purpose. Furthermore, even when two STTC aircraft are deployed, AAR force generation activities, a critical activity for the fighter force, could continue. Assuming the number of aircraft dedicated to strategic airlift and VIP transport remain the same as today, the RCAF should acquire five STTC aircraft plus those required by NORAD. Table 1 breaks down the recommended minimum number of platforms.

Table 1 – Recommended minimum number of STTC aircraft

Mission	Recommended minimum number of STTC aircraft
NORAD	Per routine NORAD posture
Force Projection	2
Strategic Airlift	2
VIP Transport	1
Total (not including NORAD)	5

CONCLUSION

20. Several factors need to be considered for the STTC project. The factors related to AAR can be broken down into three categories: NORAD, Force Projection, and Force Employment. The new tanker must be capable of operating from Canada's DOBs and, ideally, FOLs, to support fighter aircraft in their NORAD mandate. Furthermore, the STTC project provides an opportunity to select a platform that is capable not only of projecting aircraft abroad but, indeed, the whole fighter detachment. While the traditional RCAF strategic tanker fleet's role has been to support the force projection of fighter aircraft, in the last 10 years, the fleet has been employed in a Force Employment role

²² Richard O. Mayne, Richard, "The Canadian Experience: Operation Mobile," in *Precision and Purpose – Airpower in the Libyan Civil War*, ed. Karl P. Mueller (Santa Monica, CA: RAND, 2015), 250.

twice. This role is an excellent way for Canada, as a force contributor to alliances, to be seen as providing effects to a coalition while helping to fill a critical shortage within NATO.

RECOMMENDATION

21. In addition to the number of tankers required by NORAD, the STTC project should acquire at least five platforms. This number will allow the fulfilment of the strategic airlifts and VIP transport roles, and the NORAD, Force Projection and Force Employment AAR missions. The following is a list of recommended capabilities and considerations:

- a. Equipped with both a boom and drogues;
- b. Use the RAAF concept, using ACSO/FRS as boom operators;
- c. Two aircraft should be capable of deploying six future fighter aircraft between CFB Bagotville and the Middle East, non-stop, along with 200 people, 11 cargo pallets, and a deployable SCIF;
- d. Aircraft must be capable of operating from Canada's Deployed Operating Bases and should be capable of operating from Forward Operating Locations;
- e. Required time for aircraft ground operations must be consistent with the mandated NORAD response posture;
- f. After flying from the DOB or FOL to the operating area, the aircraft must be capable of remaining on-station for six hours, and deliver 75,000 pounds of jet fuel to receivers and return to the DOB or FOL with IFR reserves;²³ and
- g. Aircraft must be compatible with DOB and FOL airfield facilities (runway size, parking space, maneuvering areas, instrument approaches, pavement loading etc.)²⁴

²³ Only consider FOL if the tanker is deemed capable of operating at the FOL year-long. Otherwise, consider the DOB.

²⁴ For both DOB and FOL operations, the NORAD mission takeoff weight and normal landing weight, as appropriate, should be considered. The worst-case environmental conditions should be considered for DOB operations. NORAD mission takeoff weight is defined as the weight required to conduct the mission defined in paragraph 21f. Landing weight is defined as the weight of the aircraft with sufficient IFR reserves. For DOB operations, the worst environmental conditions for takeoff and landing should include: pressure altitude of 1,000 feet above airfield elevation, average maximum temperature during the hottest month of the year, wet runway and no winds. The use of thrust reversers should be as per Standard Planning Considerations for the aircraft.

22. Finally, given that the future tanker's primary user will be the RCAF's fighter force and the complexity surrounding the support of the NORAD and Force Projection missions, the STTC project office should consult with personnel from the Fighter Capability Office when it defines the project requirements.

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