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AIM

1. The aim of this service paper is to make recommendations to Commander 1 Canadian Air Division/Canadian NORAD Region on key planning considerations for the future of Canada's NORAD participation as the North Warning System (NWS) approaches its anticipated end of life in 2025-2030 timeframe. Although there are numerous potential solutions to address the concerns of northern defence it is clear that any effective solution will require the integration of multiple capabilities to address this dynamic and changing environment.

INTRODUCTION

2. Canada's partnership with the United States in defence of North America through the NORAD agreement requires continuous investment from both countries to address the changing geopolitical environment and rapid changing technological environment. Looking forward to 2025-2030 the anticipated end of life for the current NWS long range and short range radars it is important to consider current capability gaps, as well as other environmental changes affecting Canada's arctic that may impact the decision on what the new NWS should consist of.

3. This paper proposes key considerations that should be included in the development of the needs analysis for the replacement of the current NWS. The considerations that are explored within this paper include:

   a. extending the area of radar coverage further north to include the entirety of the Northwest Passage;
   b. maximising the radar coverage throughout Canada in response to the Operation Noble Eagle mandate;

c. incorporation of next generation stealth defeating radar technology;

d. incorporation of low altitude radar coverage to track low altitude cruise missile threats;

e. cost effective alternative to reliance on US AWACS including space based radar capabilities;

f. collocation of CADS with CANR HQ; and

g. continued consideration for Canada's participation in a ballistic missile defence program.

DISCUSSION

4. The current NWS consists of 15 long range radar sites (11 within Canada) and 39 short range radar sites (36 in Canada) the system became fully operation in 1993. The system provides a 4,800 km long and 320 km wide continuous line of radar coverage from nearly ground level to 100,000ft stretching from Alaska to southern Labrador.[1] Three additional and similar Canadian coastal radars complete the east and west coast coverage of Canada. Although the NWS is currently in the midst of a life cycle upgrade to extend its service until 2025-2030, given the expense and long lead time to replace such a massive system, the time to make decisions about its eventual replacement is now. There exist already several capability gaps that cannot be addressed by the current system and it is anticipated that additional gaps may arise before the system is replaced.

5. According to James Fergusson's article in the National Post, it is expected that over the next decade there will be an exponential increase in shipping and resource exploration through

[1] N. F. Jamieson and Canadian Forces Command and Staff College, *Should the Arctic Region North of the North Warning System be Protected by a Ground-Based Radar Surveillance System?* (Toronto, Ont: Canadian Forces Command and Staff College, 1989), 2.

Canada's north.[2] The current NWS range of coverage does not extend to cover the majority of the Northwest Passage. If the projections are accurate for the increased use of this as a major shipping route, then the RCAF can expect to see significant increase in tasks in these areas including for search and rescue as well as to assist in legal enforcement of the use of the water way. Andrea Charron argues that these threats will be a norther sovereignty issue that "will demand more military vigilance and potentially more coordination with public Safety Canada and Homeland Security agencies."[3] With limited radar coverage in this area, risk to RCAF crew operating in these remote areas is significant. By extending the NWS range of coverage to include the entirety of the Northwest Passage, would position Canada and the RCAF to be more readily able to respond to an increase in future tasks in this area. Current ground based radar systems are not ideally suited for tracking ships at sea. Significant progress is currently being made in the development of space based radar systems which would be more suitable for the tracking of ships in Canada's North. A partnership with US efforts currently underway to field such a capability would meet Canadian needs in the tracking of shipping vessels in the North.

6. As a result of 9/11 Operation Noble Eagle was initiated, this shift in mentality from an outward looking defensive capability to an inward looking protection, situational awareness and control posture presents a challenge when considering the vast size of Canada's arctic. The current North Warning System was designed primarily as a "Trip Wire" and to assist in guiding interceptor air craft to engage threats as they arrive from over the pole. Now however, Operation Noble Eagle is focusing on the need for maximum control of air space over the continent. In Canada there are significant gaps in radar coverage most notably in the north. Any new radar

[2] James Fergusson, "Up in the Air, North of 60," *National Post*2013.
[3] Andrea Charron, "Canada, the Arctic, and NORAD: Status Quo Or New Ball Game?" *International Journal* 70, no. 2 (2015), 216.

system installed as a replacement to the current North Warning System should be focused on area coverage and not just a new “trip wire”.

7. As stealth technology is beginning to see more widespread use in strategic bombing and multi role aircraft design. Any replacement radar system should be addressing this concern by providing significantly improved resolution. The radar cross section of an aircraft cannot be completely eliminated by current stealth technology. Current stealth technology simply reduces the radar cross section of an aircraft to a level below the resolution that current radar systems are able to detect. The Chinese military have made significant advances in what they call passive stealth defeating technology that triangulates an aircraft’s position using an array of sensors that “listens” to the electronic emanations from aircraft. According to an article by Ankit Panda entitled “How Effective Is China's New Anti-Stealth Radar System, Really?”, “Chinese sources claim that the DWL002 passive radar system will render the F-22 and F-35 obsolete.”[4], while this statement is not likely completely accurate it can be inferred that the Chinese government is confident that this new system will aid in defeating current stealth technology. As new technology to address the stealth problem is being developed, the chosen replacement radar systems for Canada’s north should take this into consideration and employ stealth defeating technology to increase the probability of successful interception of stealthy aircraft.

8. Low altitude air craft launched long range cruise missiles represent the most significant vulnerability to the current North Warning System. The current ground based radar systems have difficulty acquiring radar signature of these cruise missiles when travelling at low altitudes and using the contours of the land to hide in the radar shadows of ridgelines. Alexander Panneta

[4] Ankit Panda, "How Effective is China's New Anti-Stealth Radar System, really?" *The Diplomat*, October 6, 2014, 2014.

reported in April 2015 that "[t]he U.S. military is preparing to ask that new sensors be installed in the Canadian Arctic that would be able to track different types of incoming missiles."[5] New technologies are currently being developed that will address these threats. Specifically, Space based radar systems with nearly vertical look down angles provide the best chance of detecting such threats as the radar dead zones are nearly eliminated. An alternative option would be to install ground based radars on the northern most coast line. This would eliminate terrain dark spots in radar coverage, however it would present challenges in relaying the data as the northern coast line is well out of range of current geostationary satellite reach. Therefore a line of microwave links would need to be installed for each sensor, significantly increasing the installation and maintenance cost. The next generation of the North Warning System will likely need to leverage either a space based radar technology or invest in a new network of northern coastal radar systems in order to provide reliable coverage of North America's norther approach at low altitude.

9. Due to budget restructuring the US AWACS program has seen reduced flying hours and reduced numbers of platforms to operate from. The 2016 US budget reveals that a further seven AWACS aircraft will be divested by 2019.[6] Traditionally the AWACS had been the most reliable RADAR tracking and situational awareness asset. It did not suffer the same radar blind spots to low altitude threats that ground based radar systems were susceptible to. Given its high cruise altitude and long loiter time the AWACS filled a critical role in NORAD. If budget restrictions continue it is more likely that the availability of AWACS for coverage in Northern Canada will

[5] Alexander Panetta, "U.S. Military to Ask Canada to Install Better Missile Sensors in Arctic: Senior Defence official," *National Post*, sec. News, April 8, 2015, 2015.
[6] Office of the Under Secretary of Defense Chief Financial Officer, "2016 Budget Request" (Internal Budget Request, US Department of Defense, 2015).

be further reduced, as such alternative options should be explored such as the previously mentioned space based radar system currently under development by the US DOD.

10. The C2 structure of CANR is currently decentralized with Canadian Air Defence Sector (CADS) located in North Bay and CANR HQ located in Winnipeg as a combined HQ with 1 CAD. CADS has the responsibility for maintenance and operation of Battle Control System Fixed (BCS-F), the network environment which integrates the sensor feeds from the NWS radars and airfields across Canada and develops the air picture, including tracking and target identification for the Canadian NORAD Region. This air picture is then fed into the Combat Air Operations Centre (CAOC) in CANR HQ. In an effort to be as efficient as possible the RCAF has indicated a desire to divest itself of CFB North Bay and to collocate CADDS with CANR HQ in Winnipeg. The challenge in effecting this change in the past has been the requirement for this to occur seamlessly and the significant cost associated with duplicate networking. The upgrade of the NWS presents the ideal opportunity to affect this change as a complete overhaul to the network architecture will be required regardless of where the system is terminated and historically this has involved the establishment of a duplicate network to cut over from old systems to new ones even if they are not moving. Therefore, if the long term plan is to collocate CADS with CANR HQ then it should be incorporated as a function of the NWS replacement.

11. The need for a ballistic missile defence (BMD) system in Canada has been a much debated topic for decades. David McDonough's article, Canada, NORAD, and the evolution of strategic defence, describes the history of Canada's decision making process with regards to strategic missile defence[7]. It also postulate future trending based on those decisions. In the mid

[7] David S. McDonough, "Canada, NORAD, and the Evolution of Strategic Defence," *International Journal* 67, no. 3 (2012), 797-811.

80's Canada's response to the US Strategic Defense Initiative (SDI) was an indication that Canada would invest in the development of four forward operating locations (FOL), invest in a larger fleet of maritime patrol aircraft and pursue the acquisition of an AWACS capability.[8] Today's reality sees that only one of the four FOLs is regularly used as the others have fallen into disrepair, the Aurora fleet size has been reduced rather than grown and Canada has not acquired an AWACS capability and in fact recently ceased its contribution to the NATO AWACS program. These realities leave Canada more exposed to threats from ICBMs then it was in 1983 when Ronald Reagan first launched the SDI program. The single constant in all discussions regarding BMD is the presence of a threat. The decisions made to not participate in BMD programs have consistently revolved around financial concerns. These concerns should not be a factor in recommendations made from CANR but rather left to the political level to determine funding priority. This headquarters should continue to identify the risks and recommend solutions to address those risks; regardless of previous decisions, a BMD program should be included in the solution set of possible risk mitigation measures to deal with the current ICBM threat and threats from nations currently developing ICBM capabilities.

12. The Canada First Defence Strategy highlights the concerns that changing weather patterns are making the arctic waters of Canada more accessible and "could also spark an increase in illegal activity, with important implications for Canadian sovereignty and security and a potential requirement for additional military support."[9] Although the Canada First Defence Strategy identifies NORAD operations and operations in the arctic as a core mission in Canada moving forward, there as of yet has been no formal indication of infrastructure funding having

[8] D. M. McRae and Gordon R. Munro, *Canadian Oceans Policy: National Strategies and the New Law of the Sea* (Vancouver: University of British Columbia Press, 1989), 183.
[9] Canada. Dept. of National Defence and Canada. Ministère de la défense nationale, *Canada First Defence Strategy* (Ottawa, Ont.: National Defence,[2008]).

been set aside for the replacement of the North Warning System or capital investment for new situational awareness capabilities for the North. Given the likely high cost associated with infrastructure renewal and capability development to replace the NWS, securing capital investment early is essential to the planning process.

CONCLUSION

13. Although the 2025-2030 end of life for the current NWS fleet of radar systems may seem like a next horizon issue, the planning considerations that will shape the next generation of Canadian participation in NORAD are issues of today. This paper has demonstrated that the following are essential considerations for the planning of the future of Canadian northern defence:

a. increasing the northern radar coverage to include the entirety of the Northwest Passage;
b. maximising the NWS radar coverage of northern Canada in response to Op Noble Eagle mandate;
c. ensure that the next generation of radar systems implemented employ stealth defeating radar technology;
d. employment of either satellite based radar technology or new norther coastal low altitude ground based radar systems to address the threat from low altitude cruise missiles;
e. the declining availability of US AWACS aircraft for control in Canada's north for non NORAD missions;
f. collocation of CADS and CANR HQ in Winnipeg; and

g. continue to provide to the political level the risk vs reward of participation in a joint Canada US ballistic missile defence program.

RECOMMENDATION

14. It is recommended that Commander 1 CAD/CANR HQ initiate a planning cycle aimed at defining the future of Canadian contributions to NORAD as the North Warning System approaches its end of life in 2025-2030 timeframe including the considerations identified in this paper.

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