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## DEFENDING CANADA'S NORTH: THE USE OF AUVS AND ACOUSTIC ARRAYS FOR SURVEILLANCE IN CANADA'S ARCTIC

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## **DEFENDING CANADA'S NORTH: THE USE OF AUVS AND ACOUSTIC ARRAYS FOR SURVEILLANCE IN CANADA'S ARCTIC**

### **AIM**

1. Canada's new defense policy Strong, Secure, Engaged, (SSE) - provides the framework that will guide Canadian military leaders as they plan to meet the Canadian government's aims now and into the foreseeable future. A major portion of the document refers to the need for the Canadian Armed Forces (CAF) to "increase presence in the Arctic."<sup>1</sup> This service paper is for the Director General of Naval Force Development (DGNFD), Rear-Admiral Hawco, and will provide the following recommendation: by using direction from within SSE to, "prioritize Arctic Joint Intelligence, Surveillance and Reconnaissance as a defence research and development priority to produce innovative solutions to surveillance challenges in the North"<sup>2</sup> request that Defence Research and Development Canada (DRDC) continue to research ocean floor listening arrays and Autonomous Unmanned Vehicles (AUV) with the intent of designing a networked surveillance system capable of year round operation in the arctic.

### **INTRODUCTION**

2. SSE provides planning guidance to Canada's defense team with three main overarching priorities. These priorities allow military planners to prepare for operations today and into the future which they will be expected to execute effectively by the Government of Canada. The first priority is to have the capabilities that are required to defend Canada's sovereignty against any threats, (Strong at home).<sup>3</sup> Secondly, the CAF needs to continue to be able to defend North

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<sup>1</sup> Minister of National Defence, "Strong, Secure, Engaged" (Ottawa, 2017), pg 14.

<sup>2</sup> Ibid, pg 69.

<sup>3</sup> Ibid, pg 4.

America with our American allies by, “enhancing our NORAD commitments and by continued close ties with the United States (US)”<sup>4</sup> (Secure in North America). Finally, Canada will be able to do its part to “contribute to world peace and stability largely through the deployment of the CAF,”<sup>5</sup> (Engaged in the world). SSE articulates very strongly that a large portion of the above effort will be focused on the arctic which is affected by all three of the pillars set forth above.

3. The RCN’s Strategic Plan 2017-2022, “necessitates that the RCN not only remains aligned with higher level intent but that we continue to look beyond the immediate horizon and continue to chart the longer-term direction of the Navy.”<sup>6</sup> A secure Canadian Arctic ensures that Canada interests are protected, is important within the context of North American defense, and the North Atlantic Treaty Organization (NATO) alliance as well. It is critical that the RCN remain capable of defending Canada’s three coastlines to counter all threats, especially those developing in the arctic. This is important not only for Canadian interests but increasingly for the interest of all NATO countries. Traditionally there was very little need to worry about defending this region, however with the change in the global climate this is no longer the case. With ice coverage in the arctic receding at an accelerated pace it is expected that human presence in the arctic will only increase.<sup>7</sup> “Eight states – Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States – have territory north of 60, while five of these states border the Arctic Ocean,”<sup>8</sup> while other states such as China have shown much interest in the region.<sup>9</sup>

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<sup>4</sup> Minister of National Defence, “Strong, Secure, Engaged” (Ottawa, 2017), pg 14.

<sup>5</sup> Ibid, pg 4.

<sup>6</sup> Chief of the Naval Staff, “RCN Strategic Plan 2017-2022,” 2016, pg7.

<sup>7</sup> Lauren James, Jason Treat, Ryan Williams, Chiqui Esteban, and Chris Combs, "See for Yourself: How Arctic Ice Is Disappearing," National Geographic, , accessed February 03, 2018, <http://ngm.nationalgeographic.com/2016/01/arctic-ice-shrinking-graphic-environment-text>.

<sup>8</sup> Minister of National Defence, “Strong, Secure, Engaged” (Ottawa, 2017), pg 50.

<sup>9</sup> Christoph, Seidler. "The Resource Race: China Dips Toes in Arctic Waters - SPIEGEL ONLINE - International." SPIEGEL ONLINE. January 25, 2013. Accessed February 03, 2018.

Therefore, “acknowledging rising international interest in the Arctic, Canada must enhance its ability to operate in the North and work closely with allies and partners.”<sup>10</sup> This is particularly relevant in the underwater domain.

## DISCUSSION

4. Canada has a long tradition of submarine operations dating back to 1914.<sup>11</sup> The RCN’s current Victoria Class diesel submarines are part of that proud lineage and are capable for their intended traditional cold war roles. However, they were not designed for arctic operations and are not suitable for most operations in the region. These submarines are slated to be in service until the mid 2030s.<sup>12</sup> Although the Navy operates with traditional diesel boats there have been significant advances in submarine technology that have significantly enhanced non-nuclear submarine technology. With these advances there are currently diesel submarines in use by our allies that could potentially be suitable for operations in the north. With innovations such as Air Independent Propulsion (AIP) systems, modern non-nuclear submarines can stay submerged for the comparable amount of time as their nuclear counterparts with drastically reduced requirements to snorkel.<sup>13</sup> However, with the timeline to replace the current Victoria Class submarines over a decade away, planning for an arctic capable submarine is not a feasible solution to meet the current defense requirements in the arctic. Therefore, other solutions must be sought out.

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<http://www.spiegel.de/international/world/growing-chinese-interest-in-the-arctic-worries-international-community-a-879654.html>.

<sup>10</sup> Minister of National Defence, “Strong, Secure, Engaged” (Ottawa, 2017), pg 57.

<sup>11</sup> <https://www.canada.ca/en/navy/services/history/canadian-submarine-history/canadian-submarine-history.html>

<sup>12</sup> Minister of National Defence, “Strong, Secure, Engaged” (Ottawa, 2017), pg 67.

<sup>13</sup> “RoKN’s Seventh KSS-2 Submarine to Start Operations in May,” accessed January 31, 2018, <http://www.janes.com/article/77184/rokn-s-seventh-kss-2-submarine-to-start-operations-in-may>.

5. To remain capable of defending Canadian interests both at home and abroad the RCN must be able to predict what the CAF will have to do today to be capable against our enemies tomorrow. In the Chief of the Royal Canadian Navy's (CRCN) new strategic plan it discusses the importance of moving towards being an innovative service. "In order to ensure the RCN continues to remain combat relevant and adapts to an ever-changing environment, an RCN innovation programme will be established."<sup>14</sup> With work being conducted by DRDC and NATO allies, the challenges of operating underwater in the arctic is the perfect opportunity to use innovation and Canadian technological superiority to better enable our forces while ensuring we maintain the advantage over our adversaries.

6. DRDC has conducted numerous under ice experiments in Canada's north.<sup>15</sup> This has allowed scientists to better understand the environment and the difficulties that are faced while operating in it. Challenges such as weather, climate and acoustic propagation in the arctic are very real, however they may be overcome with properly situated equipment, equipment that is designed with the arctic environment in mind and with a better understanding of how to use the environment as advantageously as possible. The real challenge however, will lie in equipment operability and serviceability in the harsh environment. Powering the equipment in such a remote region will need careful consideration, however, the use of renewable energy is an available option. Another option is battery packs that will only have to be changed every three months with current technology, which will still limit the human footprint in the region. With these challenges in mind, acoustic sea bed arrays are one half of the solution to monitoring the

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<sup>14</sup> Chief of the Naval Staff, "RCN Strategic Plan 2017-2022." Pg 12.

<sup>15</sup> David Pugliese, "Defence Scientists in Arctic Conduct Sonar and Robotic Experiments," *Ottawa Citizen*, August 14, 2014, <http://ottawacitizen.com/news/national/defence-watch/defence-scientists-in-arctic-to-conduct-sonar-and-robotic-experiments>.

underwater realm in the north. By placing arrays near known submarine transit lanes, the RCN will have the underwater battlespace awareness that it needs to defend Canada's north against subsurface threats.

7. Autonomous vehicles or drones are a part of everyday life now in Canada. Their use in the military has steadily increased and new applications for their use are being discovered all the time. Their use for Anti Submarine Warfare (ASW) is being researched as one of the means to counter increasingly more technologically advanced submarines. This ties in well with the research that is being conducted in the arctic. AUV experiments have been conducted in the Arctic since 1972.<sup>16</sup> In a demanding climate such as the arctic "An (AUV) has a unique capability of high underwater spatial and temporal coverage, making it suitable for monitoring applications."<sup>17</sup> The ability to operate under the ice autonomously to monitor and report as required either through satellite or through the ocean floor arrays will ensure that there is constant surveillance and battlespace awareness in the north.

8. What actions should be taken once a track is detected and deemed to be a potential threat? Simply knowing that there are potential contacts transiting into Canada's Arctic Archipelago does not suffice. There must be a means of not only detecting contacts but being able to track and report contacts as well, once they are detected by the northern subsea warning arrays. Again, DRDC has a significant leadership role to play in finding the answer to this problem and have already conducted experiments that utilize AUV to track contacts with the potential of having Artificial Intelligence (AI) to even further their tracking and reporting

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<sup>16</sup> Petter Norgren and Roger Skjetne, "Using Autonomous Underwater Vehicles as Sensor Platforms for Ice-Monitoring," *Modeling, Identification and Control* 35, no. 4 (2014): 263–77, doi:10.4173/mic.2014.4.4.

<sup>17</sup> Ibid.

capability. Projects such as CAUSE<sup>18</sup> which are conducted by DRDC in concert with civilian companies aim to determine how to employ AUVs in the Arctic environment. With these projects already being conducted, now is the time to shape their focus towards the more precise requirements of the RCN in the north. AUVs are highly capable and able to effectively operate with little human interface. With technological advances these vehicles could be equipped with AI in order for them to more intelligently track and report subsurface contacts. These vehicles should be used in picket type patrols which would enhance the amount of area that could be monitored at one time but it's the ability to constantly track, report and even capture data on contacts that will make them the most valuable to the RCN.

9. The networks of interconnected sensors that can monitor and track contacts with little to no human interaction are essential to ensuring the security of Canada's Arctic waters. Although these systems, once in place, will have an incredible amount of capability and capacity there will need to be a means by which the data that is captured is transmitted in real time back to operators and analysts for assessment. SSE indicates that the Royal Canadian Air Force (RCAF) will invest in, "space-based systems that will enhance and improve tactical narrow- and wide-band communications globally, including throughout Canada's Arctic region."<sup>19</sup> These future systems can be used to not only meet the RCAF's communication and surveillance needs but can be utilized in the underwater domain as well. With these satellite systems in place they will be able to be transmitted to from the subsea systems in real time ensuring that critical contact information is sent to the proper operational hands.

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<sup>18</sup> Carmen Lucas Nicos Pelavas, Garry Heard, "Autonomous Underwater Vehicle Localization Using the Acoustic Tracking System," *The Journal of the Acoustical Society of America* 132(3):205 (n.d.): 26.

<sup>19</sup>Minister of National Defence, "Strong, Secure, Engaged" (Ottawa, 2017), pg 17.



10. This capability can be coupled with other new capabilities that the CAF expects to bring on line in the near future as well based on direction given in SSE. “The Canadian Armed Forces will acquire next generation surveillance aircraft, remotely piloted systems – commonly referred to as “drones” – and space-based surveillance assets to significantly expand its Joint Intelligence, Surveillance, and Reconnaissance capacity.”<sup>20</sup> A joint approach to the problem of surveillance in the north truly embodies the direction that the CAF is moving towards and will considerably enhance Canada’s ability to defend its territory. Not only will there now more interconnectedness which will ensure a maximum amount of capability in the north not only below the water but above it as well. “These new platforms will be integrated with existing assets into a networked, joint system-of-systems that will enable the real-time flow of information that is so essential to operational success.”<sup>21</sup>

11. The final critical component is where the information will be analysed. It is crucial that there be an ability to process the information received from the north in real time or near real time fashion if it is to be effective. Fortunately, there are already commands in place that interpret data from arrays in both the Atlantic and Pacific Oceans. The units are manned by both US and Canadian personnel which builds again on the direction from SSE to build closer ties with the US. With the capacity already in place to monitor these types of systems there will be little need for infrastructure improvement on this end of the project. Once the systems in the north are operational and able to communicate via satellite, they will simply have to transmit their data to these monitoring locations for analysis. With the expertise already in place after

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<sup>20</sup> Minister of National Defence, “Strong, Secure, Engaged” (Ottawa, 2017), pg 16.

<sup>21</sup> Ibid, pg 17.

decades of operational experience a steep learning curve will be avoided making these monitoring systems almost fully operational once they are in place.

## **CONCLUSION**

12. The need to conduct surveillance throughout Canada's north is not an issue for tomorrow. There are countries already in the world that are contesting Canada's claim to the north. This makes it vitally important for Canada to be able to show the world that it can in fact protect its territory and is in fact willing to do so. This is also important to our allies within North America and within NATO as focus could soon shift to the NATO's northern flank if Russia continues to increase its operational tempo in the region.

13. With an understanding that Canada's current submarine fleet is unable to transit underneath arctic ice and therefore unable to operate as required in that environment another option must be looked at. These capabilities will ensure that the RCN can contribute as directed in SSE in maintenance of Canadian sovereignty and the protection of North America and NATO. In the future many military operations will be conducted by either unmanned or autonomous vehicles. This service paper has outlined how autonomous vehicles and ocean floor arrays should be a cornerstone of the RCN's operations in the north. Not only are they more effective in the northern domain they are far less costly which allows more money to be spent in other areas of the defense portfolio.

**RECOMMENDATION**

14. The use of AUV's for military applications is a necessary move forward for the RCN. DRDC and other likeminded agencies throughout NATO have been experimenting with various AUVs to determine what applications they can be used for. With this already underway it is recommended that DGNFD request that DRDC shape focus its research on the application of AUVs to conduct subsurface surveillance in the arctic while at the same time request that ocean floor arrays development be continued so that they can be utilized year-round to monitor the approaches to Canada's Arctic waters. With these two capabilities fully operational the RCN will be able to meet its obligations to Canada and it's allies in the north.

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