

STARHELL

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NAVAL ASSOCIATION OF CANADA

Special Edition Submarines: Canada's Strategic Requirement

Submarines in Canada: A Tortuous History

Captain(N) [Ret'd] Norman Jolin

Canada's Future Submarine Force: Strategic Requirements

Dr. Jeff Collins

Canadian Political Leadership and the Next Canadian Submarine

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The Modern Threat Environment and Canada's Future Submarine

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The Under-Ice Environment as a Strategic Space

Dr. Adam Lajeunesse & Tim Choi

Submarine Procurement: Widening the Aperture of Options

Vice Admiral [Ret'd] Robert Davidson



Crew members of HMCS Windsor assist Members of Parliament aboard the vessel from a Rigid Hull Inflatable Boat (RHIB) during Canadian Leaders at Sea (CLaS) Program on 14 December 2017 in Halifax, NS. (Image: Chief Petty Officer 2nd Class Shawn M. Kent, CAF)





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Cover Image: HMCS *Windsor* transits Halifax Harbour with George's Island in the background in preparation for the Canadian Leaders at Sea (CLaS) Program on December 14, 2017 in Halifax, NS (Image: Chief Petty Officer 2nd Class Shawn M. Kent, Formation Imaging Services - Halifax).

HMCS Windsor transits Halifax Harbour (Image: Chief Petty Officer 2nd Class Shawn M. Kent, Formation Imaging Services - Halifax)



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vicinity of Esquimalt Harbour (Image: SI Kendrick Grasby, CAF Photo)



Dear Readers,

On June 16th, 2022 the Naval Association of Canada (NAC) held its annual conference, which this year focused on, “Submarines – Canada’s Strategic Requirement.” The aim of that event was to maintain and further the discussion on what NAC's Naval Affairs program considers to be the cornerstone to Canada's future defence and security needs - the replacement of the Victoria-class submarines.

The conference consisted of a series of presentations by four of Canada’s leading academic experts in the field of maritime security, and four former and still serving RCN members with first-hand knowledge of, and experience working with Canada’s submarine force, who presented their ideas and perspectives on Canadian defence and security issues as they relate to the undersea environment. The event addressed the geostrategic and national considerations influencing the type, size, capabilities, and the number of submarines required to meet Canada’s future defence requirements. This special edition of NAC's flagship publication, *Starshell*, contains the papers, articles and presentation material created for the 2022 annual conference.

This special edition is dedicated to the memory of our National President, Bill Conconi, who passed away in late May. Bill was a retired Naval Reservist, a yachtsman, a leader, and a mentor with many interests, not the least of which was Canadian Naval Affairs. He was totally dedicated to the Association and served for many years as a board member, Branch President, and finally as our National President.

In 2017, Canada’s government in *Strong, Secure, Engaged* (SSE), confirmed the government’s intent to maintain a submarine capability. To do so, SSE committed to the Victoria-class modernization programme to ensure the current four boat fleet will remain operationally relevant into the late 2030s. Five years later, Canada is now in preliminary discussions to replace the Victoria-class prior to the end of their service lives. The Department of National Defence is also in the process of standing up a Canadian Patrol Submarine Project and a small cadre of RCN personnel are now engaged in developing the basic requirements and costing, as well as build options. This is a critical process and time is of the essence to avoid a capability gap between the Victoria-class and the future fleet. The NAC’s continuing research, networking, and dissemination work in this field is intended to support this mission and the research and analysis in this special edition of *Starshell* is meant to reflect that.

When introducing the June event, the organizers noted that there is one word which succinctly defines Canada’s submarine requirements: deterrence. Global geopolitics are at an inflection point as the Western world comes to realize that the peace dividend of the 1990s has ended. Russia is clearly no longer a partner, while China’s economic growth has spawned hyper-nationalism irredentism, rather than the hoped-for liberalization. What the world is witnessing in the 21st Century is the return to state-on-state conflict, in which authoritarian powers actively threaten Canada’s security and the rules-based international order. While Canada is lucky to share a

border with a superpower, which shares our democratic ideals, it must still be able to protect its own sovereignty, security, economic interests, and freedoms – all while contributing to broader efforts to defend international peace and security.

The NAC believes that these national responsibilities require a strong navy – which includes a modern submarine fleet. This requirement stems from vital and widely accepted requirements. Canada must be aware of what transpires in its own waters – on all three coasts. It must also be able to deploy naval power abroad, where an underwater presence may deter or respond to aggression. Submarines offer these capabilities in ways that surface ships cannot. These platforms have proven themselves repeatedly in the past and remain a vital element of Canada's future fleet.

While defence is rarely a topic that captures national interest, the current moment offers a window of opportunity. The Russian invasion of Ukraine has brought to light the dangers of great power competition, generating renewed interest in defence, as well as a modest increase to the defence budget. It would be short-sighted, however, to draw a straight line from popular interest to results. There are still significant challenges to overcoming the persistent maritime blindness that has long characterized Canada and its inability to perceive the value of the seas – and its connection to them.

As Captain(N) Norman Jolin states in his contribution in this edition, the government of the day and the bureaucracy that supports it must be sold on the requirement and its affordability. Submarines are expensive to procure and operate, and early inaccurate and rough cost estimates can be detrimental to long-term government program support if costs are seen to be escalating out of control. Given the typical length of a major Canadian crown project, timelines will be very tight and industry partnerships will have to form early if the project is to deliver on time.

The NAC recognizes that submarines are not assets

that easily capture the attention of a nation typically consumed by domestic politics. However, the organization can play an important role in demonstrating the value of these platforms and showing how Canada's prosperity and security rests on its ability to defend the national coastline and the sea lanes of communication. To achieve this, the NAC advocates for a class of large ocean-going diesel-electric submarines with a modern combat system fitted with weapons and sensors by a Combat Systems Integrator that is compatible and interoperable with the US Navy.

In this edition you will see the ads of our sponsors, without whose generous support NAC conferences and *Starshell* would not be possible. A huge thank you to them for enabling what we think is necessary discussion and debate on the submarine requirement for Canada in the 2030s and beyond.

Please read on and contemplate the thoughtful reflections of these Canadian experts on the critical need for Canada to create a plan to replace this strategic defence and security capability. If you wish, you can connect to the original recordings of each of the conference presentations which, in many cases, amplify and expand on the content in these papers, and include some of the questions and answers from the conference. The links can be found below.

Yours Aye,



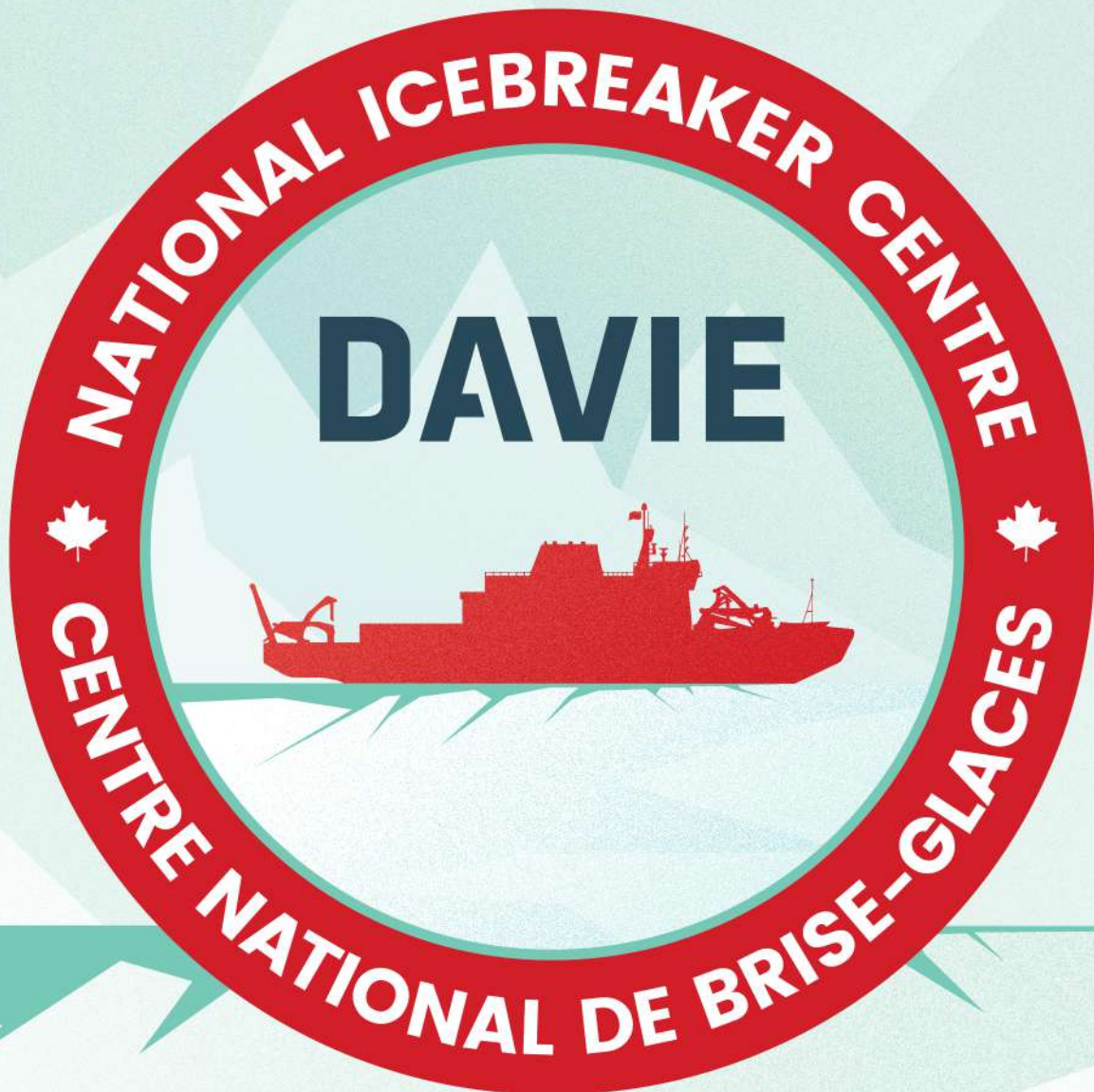
Tim Addison, NAC Director of Naval Affairs

The original recordings of each of the presentations and some of the questions and answers from the conference here:

Morning session: <https://youtu.be/NpUTvnFnfFI>

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Submarines in Canada – A Tortuous History

Captain (N) [Ret'd] Norman Jolin

Today the world's security situation is undergoing a long-anticipated return to state-on-state conflict, not seen since 1945, with Russia and China explicitly threatening world order. While defence is never a topic that captures national interest, we have of late seen a significant surge in Canadian media interest in the topic, as well as a modest increase to defence spending in the 2022 federal budget. That said, it is noteworthy that the government has yet to commit to any substantial change in defence policy and the recent budget lacked detail on future defence spending, only indicating that a "swift defence policy review" will be undertaken.¹ Notwithstanding a commitment to a future defence policy review, the Trudeau government's priorities remain focused on climate change and social programmes, priorities which are unlikely to change during the current mandate.

Despite all of this, one would think that the bellicose rise of the Russian threat would have simplified the justification for the renewal of

Canada's submarine capability. Although the crisis in the Ukraine has generated a renewed interest in defence, all indications are that Canada will continue to rely on her geographical position next to the United States of America to provide for national defence. Nevertheless, Canada has an obligation to contribute to North American continental defence and it remains a top priority for the Americans.² This should be an area where a renewed submarine capability can be justified, but it comes with challenges, notably the ability to operate submarines in the Canadian Arctic.

A future Canadian submarine capability must be able to operate in the open ocean environment of the Atlantic and Pacific, as well as possessing an ability to deny access to the Arctic Archipelago. Furthermore, the historic realities of Canadian defence budgets demand that a submarine capability must be affordable, while sustaining political support over multiple governments during the procurement process. It must also be able to provide future Canadian governments with options, with which to respond to international crises by being able to operate at great distances from Canada, for prolonged periods, in some of the most unforgiving waters in the world.



HMCS Windsor and Toronto sail out to sea on Exercise CUTLASS FURY 21 (Image: Mona Ghiz, CAF photo)

It is these three factors that have always framed naval procurement strategy, but culturally Canada sees itself as a continental state and our significant maritime geography often tends to take a back seat to national will in decision making. That fleet composition, based on a modest number of frigates and destroyers, has always been the default culture, which makes it difficult to have an educated discussion on the need for submarines, particularly if it threatens RCN cultural norms.

To stimulate the debate as to why Canada needs submarines and the challenge facing the RCN, it is worthwhile to get everyone on the same page by conducting a quick review of the tortuous history of submarines in Canada and highlight how and why decisions were made vis-à-vis that capability.

In the Beginning

The Canadian naval service was founded in 1910, with the *Naval Service Act* achieving Royal assent on May 4, 1910 and the service subsequently being renamed the Royal Canadian Navy (RCN) in August 1911. At this time the RCN fleet was basically two ships, the ex-British cruisers HMCS *Niobe* and HMCS *Rainbow*, based on the East and West coasts of Canada respectively. In August 1914 the British Empire went to war and Canada, as part of the empire, was thrust into a conflict that it was ill prepared for – a theme that will be continued throughout our history. As the Dominion government was scrambling with mobilization and liaising with Whitehall on the forces to send, the British, including the First Lord of the Admiralty (then Winston Churchill), stressed the need for Canadian soldiers and not naval forces. Suffice to say, the RCN was not top of mind for the Borden government in 1914.

However, on the eve of the First World War, a deal for two submarines that had been built in Seattle, Washington for the Chilean government fell through, and the Premier of British Columbia moved quickly to purchase them before

Canada officially became a belligerent nation. The Dominion government subsequently ratified this purchase on August 6, 1914 and commissioned them as HMCS *CC1* and HMCS *CC2* because they resembled the British C-class submarines. While this purchase was not exactly the plan of the Dominion government, the RCN now had two submarines, which it operated throughout the war, initially on the West Coast until transfer to the East Coast in 1917 where they stayed until they were paid off for disposal and scrapping in 1920. Interestingly, during the First World War, Canada built H-class submarines under licence in Montreal for the British Royal Navy. Although not of the batch of H-class submarines built in Canada, at the end of the First World War, Canada was gifted two H-class submarines by Britain (*CH-14* and *CH-15*) which were commissioned into service in the RCN on April 21, 1921. However, by 1922, dramatic cuts in defence spending caused the RCN to give up its submarine capability and the submarines were paid off on June 30, 1922.

In the interwar years Canada was not interested in pursuing a submarine capability and all efforts were focused on maintaining a mobilization base of personnel through the naval reserve and slowly growing the fleet of destroyers. On September 10, 1939, the RCN entered the Second World War with a small fleet based on six destroyers and, over the course of the war, grew to over 400 ships, though no submarines. The RCN remained a destroyer navy



Canadian Submarine CC-1 (Source: Maple Lead, DND)

with ambitions in naval aviation.

The point to take away is that notwithstanding the huge impact that submarines had on naval warfare in the first half of the 20th century, Canada was more interested in aviation than submarines, and then only in their role as training vehicles for anti-submarine forces. Undoubtedly, the image of submarines engaged in anti-commerce warfare, particularly in the Battle of the Atlantic, and US President Roosevelt's infamous "rattlesnakes of the seas" categorization of the U-boat threat, with the image of sinking merchant ships, defined public perception about submarines.³ But it was the first modern submarine, the German Type XXI *Elektroboot*, that would soon fuel the post-war realization that the best ASW weapon was in fact another submarine.⁴

Post Second World War

With the cessation of hostilities with Germany in 1945, two Type IX U-boats surrendered to the RCN, *U-190* and *U-889*. These were commissioned into the RCN for tests and trials and not as operational submarines (*U-889* on May 14, 1945 and *U-190* on May 19, 1945). *U-889* was subsequently turned over to the USN on January 12, 1946 and *U-190* was paid off on May 24, 1947 and sunk on Trafalgar Day 1947 in the spot where she had sunk HMCS *Esquimalt* in 1945. To be clear, these submarines were never intended to be a real Canadian submarine capability, rather they were operated (mainly surfaced) for trials in support of anti-submarine weapons and sensors.

At this time the US Navy had realized the threat potential of new construction Soviet submarines based on the German Type XXI design, which would subsequently become the Project 611 (Zulu), Project 613 (Whiskey), and Project 633 (Romeo) classes. In 1949 the US Navy initiated Project *Kayo*, which included the establishment of a Submarine Development Group that was tasked with "solving the problem of using submarines to detect and destroy enemy submarines." In 1951, the first submarines explicitly designed for that mission – the SSK – SS for submarine and K for killer – became available, later known as the Barracuda-class SSKs.

The Cold War

The RCN's immediate post war plans envisioned aircraft carriers, cruisers and flotillas of destroyers, however, demobilization and post-war fiscal realities of the late 1940s saw the fleet significantly reduced, although the introduction of naval aviation did continue apace. The Korean War, and the subsequent start of the Cold War, was the stimulus for post-war naval construction with an emphasis on ASW capability. While the fleet was being rebuilt in the 1950s around the new St. Laurent-class destroyer-escorts, a submarine capability, for ASW training, was provided by the Royal Navy, not the Royal Canadian Navy. The British 6th Submarine squadron (SM 6) provided two A-class submarines on a rotational basis to the Atlantic fleet from 1954 until 1967. The crews were a mix of British and Canadian submariners, under the operational and administrative control of the RCN Flag Officer Atlantic Coast. The west coast relied upon "borrowing" USN resources for training.

In 1958, Vice-Admiral Harry DeWolf, the RCN Chief of the Naval Staff, faced with the fiscal reality that the navy must be affordable if it was to survive, made the decision that the RCN would specialize in ASW. This was the catalyst of a balanced Canadian fleet that necessarily included a submarine capability, although initially only for the training of ASW forces. Almost paradoxically, a year earlier, not only had the RCN decided it needed to acquire submarines, but it was also seriously looking at nuclear-powered submarines.

The US Navy envisioned the need for an easily massed-produced submarine that would counter the hundreds of advanced Soviet submarines expected to be in service by 1960.⁵ While by 1960 the Soviets had built 320 new submarines, of which 215 were the Whiskey-class, significantly eight were nuclear powered. This caused the shift to nuclear powered submarines, as a more effective blue water ASW submarine, initially for the reasons of speed but later to counter the new threat Soviet submarines represented. Heretofore the primary concern over Soviet submarines was the interdiction of the Sea Lines of Communication (SLOCs), however, cruise and ballistic missile firing submarines now threatened the homeland and consequently became a higher

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ASW priority. Moreover, as nuclear-powered submarine numbers increased in the 1960s, conventional submarines were seen as a better shallow water and choke point ASW submarine.⁶ In short, if you want a meaningful ASW capability in your navy, your navy must operate submarines.

Initial discussions were held with the US Navy and, in 1961, Canada acquired HMCS *Grilse*, a retired US Navy Balao-class submarine (the former USS *Burrfish*) on a five-year lease agreement – to be based on the West Coast of Canada. At this time RCN planning was in place for a new fleet which would include six of the latest American Barbel-class conventional submarines, as aspirations to transition to nuclear submarines (SSNs) were too expensive.⁷ But even this modest ambition proved to be too costly and in March 1962 it was decided to acquire three of the less expensive British Oberon-class conventional submarines, modified to meet Canadian requirements, to replace the British submarine support – all to be based on the East Coast of Canada. It is worthy of

note that the Canadian Oberons were modified from build to accept the MK 37 torpedo system which was a swim-out weapon. While not required for the MK 37 torpedo, the torpedo tube dual pressure firing system was retained and allowed Canadian Oberons to discharge British torpedoes, mines and later the MK 48 torpedo. The point being, there were Canadian modifications to the British design on build, but these changes were modest and retaining design items where it was cheaper to do so provided future flexibility. At this stage it is important to remember that submarines were being procured for the provision of ASW training, the rationale was not for the conduct of submarine operations, something that would eventually change.⁸

Canada commissioned the first Canadian Oberon-class submarine, HMCS *Ojibwa* on September 23, 1965 at Royal Navy Chatham dockyard. Of note, the submarine had been laid down as HMS *Onyx* but was switched in build resulting in an internal configuration that differed from the other

two Canadian O-class submarines.⁹ On June 22, 1967 HMCS *Onondaga* was commissioned at Chatham and the last Canadian O-class was HMCS *Okanagan* commissioned on June 22, 1968, also at Chatham dockyard. In 1968 the submarine capability on the West Coast was replaced with another ex-US Navy conventional submarine HMCS *Rainbow* (former USS *Argonaut*) which Canada purchased and operated until 1974 when, due to budget limitations, it was retired without replacement.

But it was also in the 1970s that Maritime Command realized that submarines offered Canada more than just training vehicles, they had the ability to provide a significant ASW capability, but to do this they needed modifications and upgrades. In line with similar modifications being conducted by the Australians to their Oberon-class submarines, Canada's three submarines were upgraded in the 1980s with new fire control, sonar, and communications equipment under the Submarine Operational Update Project (SOUP). It was followed by the replacement of the MK 37C Mod 2 torpedoes with MK 48 Mod 4 torpedoes and later the bow sonar with Type 2051 Plessey Triton.

At the same time a replacement submarine project for the Oberons was stood up. Named the Canadian Submarine Acquisition Project (CASAP), it was to acquire six conventional submarines as a replacement for the Oberon-class patrol submarines that had been built for Canada in the 1960s. However, the Conservative government's 1987 defence policy decided Canada needed an Arctic under-ice capability and the project was re-scoped to acquire 10-12 SSNs and renamed CASAP-SSN.¹⁰

In support of the envisioned requirement for a significant increase in the number of trained submarine personnel, Canada procured a recently retired British Oberon-class submarine for alongside training. In 1989 the ex-HMS *Olympus* was transferred to Canada not as an operational submarine, but as an alongside Harbour Training Submarine. Contrary to some reports, this submarine was never commissioned by Canada.¹¹

However, by 1989 the costs associated with operating nuclear-powered submarines proved too great in competition with other government fiscal priorities. As a part of a re-assessment of political

priorities in 1989, the ambitious 1987 defence policy was essentially abandoned, and the CASAP-SSN project was stopped in April 1989. Unfortunately, this was the same time the Cold War was ending, and the original submarine replacement project subsequently became an early casualty of reduced defence expenditures, as did the third batch of six Canadian Patrol Frigates. This latter point is significant, as the budget of the original CASAP (SSK) project had been combined with the third batch of frigates as a placeholder against the then \$8 billion estimated SSN project costs for CASAP-SSN.¹²

Post Cold War

In the 1990s the government of Canada needed to address a huge budgetary deficit and there was no funding for a replacement submarine force, nor with the collapse of the Soviet Union was there a sellable rationale for maintaining a submarine capability. That said, the UK was going through similar defence reductions and, in 1994, declared their four new Upholder-class conventional submarines surplus to requirement. According to 2005 Standing Committee on National Defence and Veterans Affairs report on the Victoria-class submarines "the Navy evaluated the British submarines in 1995 in preparation for their imminent acquisition, but the Cabinet decision to go ahead was delayed. Concerned about competing demands on the federal treasury during a period of fiscal restraint and the possible public reaction to the announcement of such a military equipment purchase, Prime Minister Chretien delayed approving the project at that time. Months of delay turned into years and the project was finally approved by the Cabinet only in 1998."¹³

Finally, after external pressure from the United States, where two successive US Secretaries of Defense strongly recommended that Canada maintain a conventional submarine capability as a meaningful contribution to North American defence, the Liberal government agreed to purchase the four Upholder-class submarines. An interim solution, entitled the Submarine Capability Life Extension (SCLE) project; this was not a replacement project for the Oberon-class, rather it simply allowed Canada to maintain a submarine capability until such time as a

replacement project could be stood up.¹⁴

This decision also came at the end of the service lives of the three Canadian O-class submarines, with HMC *Ojibwa* paying off on May 21, 1998, followed by HMCS *Okanagan* on September 12, 1998 and HMCS *Onondaga* remaining in service until July 28, 2000. *Ojibwa* and *Onondaga* were saved from the breakers yard and are museums in Port Burwell Ontario and Rimouski Quebec respectively. Regrettably, arguably the nicest of the three, *Okanagan*, did not survive.

The paying off of *Ojibwa* and *Okanagan*, while running *Onondaga* to generate submariners, allowed for the nucleus of crews to be transitioned to the four ex-Upholder-class submarines that were being reactivated at Barrow-in-Furness in the UK as follows:

- HMCS *Victoria* (ex-HMS *Unseen*) commissioned December 3, 2000
- HMCS *Windsor* (ex-HMS *Unicorn*) commissioned October 4, 2003
- HMCS *Corner Brook* (ex-HMS *Ursula*) commissioned June 29, 2003

- HMCS *Chicoutimi* (ex-HMS *Upholder*) accepted October 2, 2004 and suffered a major fire while transiting to Canada which significantly delayed her entry into service. Commissioned September 3, 2015.

Since entering service, the Victoria-class have completed their Canadianization refits which replaced a number of the fitted British systems that were not compatible with Canadian systems and difficult to support. Specifically, Lockheed Martin Canada and Northstar Technical Inc upgraded and installed the submarine's Lockheed Martin Librascope Torpedo Fire Control System (TFCS) that had been previously fitted the Canadian Oberons. This was necessary to meet Canada's operational requirements in support of the heavyweight MK 48 torpedoes which are in Canadian service – the British do not operate the MK 48 torpedo. As well, the communications suite had to be changed to meet Canadian national requirements, which included the fitment of a UHF DAMA satellite communications system.¹⁵ In 2005 Northrop Grumman Sperry Marine was awarded a contract to provide the Mk 49 inertial navigation system, based on ring laser gyro technology, which is common with



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the Canadian surface fleet.¹⁶ Initially the submarine's fitted sonars were retained (the Canadian Towed Array Sonar (CANTASS) was integrated into the towed sonar suite) since then, the sonars are continuing to be upgraded, most recently by fitting the US AN/BQQ 10 sonar, which is common with the US Navy Virginia-class SSNs and is a significant upgrade to the fitted sonar suite.

In 2017, Canada in *Strong, Secure, Engaged*, confirmed the intent to maintain a submarine capability by committing to upgrade the Victoria-class under the Victoria-class Modernization Programme, which will ensure these submarines remain operationally relevant until the end of their service lives in the mid-late 2030s.¹⁷

In 2021 the Commander RCN announced his intention to conduct a preliminary investigation into a future Canadian Patrol Submarine project.¹⁸ Thus, twenty-four years after SCLE, Canada is now on the cusp of forming a Canadian Patrol Submarine Project to deliver a submarine capability before the service lives of the Victoria-class submarines end in the late 2030s. In sum, Canadian naval history has shown that:

- a replacement submarine capability is not guaranteed.
- the number of submarines that Canada requires has never been calculated by objective analysis, rather this has been a reflection of what was available (Victoria-class) and/or affordable (Oberon-class).
- the submarines Canada acquired were military-off-the-shelf (MOTS) with minimal Canadianization on delivery.
- the submarines Canada acquired were not built in Canada.
- a submarine capability is difficult to rationalize (and sustain) within and between government(s).
- the RCN's priority has historically been the surface fleet based on frigates and destroyers.

Today

The naval staff are now engaged in developing the

basic design requirements of a Canadian submarine, numbers and rough order of magnitude costing, as well as build options which are critical if Canada is to avoid a gap in capability when the Victoria-class reach the end of their service lives. This will be a Herculean task for such a small team, and to succeed they will need to quickly focus on an affordable solution that will be supportable by at least five successive federal governments.

Based on historic project timelines Canada is very late to the game - the only remedy being the avoidance of delays in the procurement process and the reduction of build time. As no Canadian shipyard has a submarine build capability, the time to tool up a yard for submarine construction would be prohibitive for the initial orders. Total project costs, not just the sail-away price per unit, will govern overall numbers to be acquired, with the RCN keen to have a supportable number of submarines on each coast. As the RCN is looking to replace the Victoria-class submarines by the late 2030s, project timelines will be very tight and industry partnerships will have to form early if the project is to deliver on time.

This necessarily raises the entire procurement process and how to avoid delays historically encountered in major capital projects of this size. It is important for the RCN to manage the entire process, even though as the Project Sponsor, the Commander of the RCN will not have total control. Success in previous projects (e.g. the Canadian Patrol Frigate project) can be directly attributable to a consistent and sustained effort by the naval leadership to avoid delay.¹⁹ So, in addition to surviving at least five federal governments, it must remain a top overriding priority for the incumbent Commander of the RCN throughout the process.

This latter point is significant, because in Canadian defence procurement there are a number of important factors to consider. First, the government, in particular the bureaucracy that supports the government of the day, must be sold on the requirement and its affordability. Submarines are expensive to operate, and early inaccurate and rough acquisition and support cost estimates can be detrimental to long-term government program support if costs are seen to be escalating out of control. As we have seen, selling submarines to the Canadian

government has always been very difficult and the fiscal conditions of a post pandemic economy are not optimal. Moreover, if the cost of a replacement submarine capability risks displacing the planned force mix of the surface fleet, our history has shown that it may lack support from within the RCN itself.

The Canadian procurement process will demand a competition and the result will most likely be bidders offering a version of an existing conventional submarine design, modified to meet Canadian requirements, accompanied by assurances of a timely build process for the initial tranche of submarines and to undertake business activity in Canada equal to the value of the contracts they have won.

This process will be demanding and can allow for surprising results. At this stage what weight various factors will have in a technical assessment, specifically proven build time, has yet to be determined. Furthermore, in addition to pricing, how a bidder responds to the offset requirements could very well influence a tight competition.²⁰ That said, it is clear that if Canada is to replace the existing submarine capability, without gapping it, then the solution will be found in a consortium marketing a minimally modified existing conventional submarine design, built in an experienced submarine building yard in conjunction with an experienced combat system integrator.

Conclusion

The shift to the threat of state-on-state warfare may indeed have made it easier to justify a renewal of

Canada's submarine capability, but it must be realistic. In that it must be affordable and sustainable as part of a total Canadian defence solution. However, what is unknown at this time is how submarines will factor into the overall military force assessment against other priorities resulting from the dramatically changing international security situation. The bottom-line is that, notwithstanding recent international events, a replacement submarine project remains a big issue for the RCN and history has shown it is not going to be easy; but what of Canadians *writ large*?

Finally, leading and managing a submarine replacement project will require sustained leadership and priority at the highest level of the RCN and government over a period of 20-25 years. The RCN now has an opportunity to drive a submarine replacement project through government, but it will be a challenging endeavour in a post-pandemic fiscal environment that is competing for resources with the other environments. In addition to unforecasted defence expenditures resulting from the crisis in Ukraine, there is a significant unknown cost of continental defence which is becoming much more than NORAD renewal and it is a must do for any government, regardless of political ilk - but are submarines considered to be part of this requirement?

Submarines are not something that captures a nation typically more focused on social programmes and this is where the Naval Association can play an important role, as there is a need to educate Canadians on not only why we need to maintain a submarine capability, but why we need to move now on a replacement project.

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Canada's Future Submarine Force: Strategic Requirements

Jeff Collins, PhD

Canada's submarine force is due for a new fleet, a process that will be both resource intensive and politically challenging. This process is made all the more difficult by the fact that such programs must be sold to a Canadian public, which is largely unfamiliar with the contributions made by the country's submarine fleet. This is made more challenging given how difficult it is to convey that strategic rationale, given the secret nature of many submarine missions. Yet possession of submarines has been, and remains crucial, to the RCN, and that value will also only increase as great power competition grows more dangerous. Should the government fail to maintain and renew Canada's submarine capability, it increases the risk of a Royal Canadian Navy (RCN) capability gap. In practical terms, if that were to happen the government of the day would be left with few feasible or politically viable options to achieve identified national security objectives – from coastal surveillance to national and continental defence.

Canada's current naval policy document, *Leadmark 2050*, makes it clear that the purpose of the RCN is to defend “the global system at sea and from the sea, both at home and abroad.” To do this, the navy requires a fleet “of sufficient size” capable of continuously deploying across Canada's three oceans and responding to major international crises. Within that framework submarines play a vital role across the defence and security spectrum.

The Navy's first priority has always been the defence of Canada. In this, submarines are a unique strategic asset, both in their kinetic effects but also their deterrence impact. The actual or inferred presence of a submarine, with its endurance, stealth, and modern weapon systems like the Victoria-class' MK-48 torpedoes, can alter an opponent's strategic calculus.¹ In this sense, the submarine is a “classic

force multiplier” that requires a “disproportionate response from an adversary.”² The British demonstrated this bluntly in the 1982 Falklands War when the submarine HMS *Conqueror* sank an Argentine cruiser, which then led to the complete retreat of the Argentine surface fleet, stranding the garrison of 9000 on the islands to their fate. The Royal Navy likewise struggled to track and attack an Argentine diesel-electric submarine in the war.³

Canada has also experienced the deterrent power of its submarines, albeit during its constabulary operations. During the 1995 “Turbot War” with Spain that centred on a dispute over overfishing, the mere publication of a “notice of intention” indicating the presence of an Oberon-class submarine played a pivotal role in resolving the tension between Madrid and Ottawa.⁴ Modern non-nuclear submarines have equally demonstrated their deterrence and warfighting potential in training exercises. In 2005, Sweden's AIP-powered 1,600 tonne HSwMS *Gotland*, capable of remaining submerged for up to two weeks by operating on an innovative battery power system using liquid oxygen, managed to evade and “sink” a US Nimitz-class nuclear-powered aircraft carrier during a war game.⁵ Simply put, in defending a coast, a submarine brings not only its immediate combat capability, but a psychological effect that offers an advantage capable of having strategic effect. For a country with a coastline the size of Canada's – where surface combatants cannot be everywhere – it is beneficial to possess assets that an opponent believes *might* be anywhere.

Canada has also employed its submarines productively in missions overseas in support of other national objectives. In a testament to the value of having a long-range undersea capability, in 2017-18 the submarine force completed two of its most ambitious missions: the first Canadian submarine deployment to Japan in 50 years with the HMCS *Chicoutimi*'s 197-day sail to the Far East and the HMCS *Windsor*'s 133-day NATO strategic

anti-submarine warfare deployment in the eastern Atlantic and Mediterranean, performing counter-terrorism and maritime security monitoring. There are even hints that HMCS *Chicoutimi*'s deployment involved the monitoring of UN sanctions against North Korea, something which Ottawa eventually mused publicly about committing submarines to.⁶



HMCS *Chicoutimi* secured to the deck of the EIDE TRANSPORTER
(Image: Cpl Robert Bottrill, CAF Photo)

As an unconventional security asset, submarines are essential tools. Canada's experience monitoring and deterring overfishing in the North Atlantic in the 1990s illustrates both the utility of submarines performing lower-end operations and the demand for Canada's maritime sea resources. Sea-based minerals, protein, and petroleum continue to be in demand in a food- and energy-hungry world. Monitoring and repelling breaches of Canada's EEZ and continental shelf will require the full remit of CAF resources, including helicopters, satellites, ships, and submarines working in tandem with other federal agencies to ensure that Canada's interests are maintained.

Canada's submarines are an important tool in defence diplomacy, intelligence collecting, and alliance building. Being in the "sub club" allows Canada to participate in the global Water Space Management (WSM) regime. The WSM gives Ottawa

access to classified information on allied submarine operations that are key to avoiding mutual interference at sea.⁷ Canada's 2017 defence white paper, *Strong, Secure, Engaged*, sees the Victoria-class as "a key element of the system of systems approach to maritime domain awareness" and a component of the CAF's joint ISR network.⁸ Given the shared continental alliance and focus on interoperability, the RCN integrates officers with US Navy (USN) submarine staff. The USN itself routinely seeks opportunities to train against the diesel-powered Victoria-class boats, given the prevalence of non-nuclear submarines in the world and the fact that the USN is an all-nuclear submarine fleet.⁹ Within that larger alliance context, therefore, Canada can and does contribute to global security.

Changing geopolitical currents and weapons proliferation ensure that any true blue water navy will need to incorporate submarines as part of its fleet structure.¹⁰ *Strong, Secure, Engaged* endorsed the RCN's goal of being a globally deployable "blue water navy" and the framework at the heart of this goal is the naval task group (NTG). The NTG is centred around three to four combatant vessels, including submarines, and a support ship, able to respond and sustain a global operation. British maritime strategy expert Geoffrey Till argues that the NTG formation makes the most of Canada's defence budget constraints, middle power ranking, and fleet size by offering Ottawa a balanced mix of naval capabilities to meet a range of missions like those identified above.¹¹

Changing geopolitical currents and weapons proliferation ensure that any true blue water navy, especially one that aspires to deploy one to two NTGs, will need to incorporate submarines as part of its fleet structure.¹² Several reasons for this stand out. First, with the world's longest coastline, second largest continental shelf, fifth largest exclusive economic zone (EEZ), and contested Arctic claims, Canada's ability to exert influence in its own maritime domain will be tested as the demand for

resources and northern sea access increases in the coming decades. The Victoria-class modernization project's promise to upgrade the existing submarines' near-Arctic operating capabilities in conjunction with the soon-to-open Nanisivik Naval Facility (capable of refuelling both the RCN's surface and submarine fleets) in Nunavut, point to the importance of having a strategic naval asset like a submarine in the Arctic region to perform ISR activities even if it's not capable of safely going under Arctic ice.¹³

Over the longer term, the weight of global security will fall increasingly on Canada and other middle powers. We are currently witnessing the relative decline of the United States – the longstanding guarantor of the postwar 1945 rules-based international order – due to competing internal and external pressures including fleet overstretch, divided domestic institutions, quasi-isolationism, trade protectionism, and the return of great power rivalries for the first time in 80 years. That reality puts greater pressure on American allies to invest more in defence and to help meet today's security challenges in contested waters like the South China Sea.¹⁴ This remains one of the few bipartisan areas of agreement in Washington and transcends the Obama, Trump, and Biden administrations.¹⁵

With China and Russia building up their respective nuclear and non-nuclear submarine fleets, it will become harder for Canada to ignore the need to maintain its submarine capability, even if for just ASW training and littoral ISR missions. The idea that Canada could return to its 1950s past of relying on US or UK submarines to undertake these missions on our behalf is myopic. Notably, some allies are already taking the hint. This year, the UK dispatched its first carrier strike force, including an Astute-class nuclear attack submarine, to the Indo-Pacific in support of freedom of navigation in the South China Sea and supporting regional allies.¹⁶ In this vein, Australia is also investing in new submarines, as are Germany, Spain, Norway, and the Netherlands.¹⁷

In the Atlantic, the Russian invasion of Ukraine has radically increased the threat level to Canada and its NATO allies. Threats long since considered relegated to the Cold War are threatening to re-emerge and Canada must reconsider its vital role in securing the sea lanes of communication to Europe. In

the Pacific, the rapid build-up and aggressive posture of the People's Liberation Army Navy (PLAN) and Beijing's large maritime militia fleet in the South and East China Seas continues to foster a market for submarine acquisitions in the wider Indo-Pacific, now home to most of the world's submarines. Of the world's estimated 43 states with submarines, 13 are Indo-Pacific coastal states. Not counting the small and coastal ranging midget submarines that Pakistan, Vietnam, Iran, or North Korea use, the region is home to 153 of the world's 407 known active submarines.¹⁸ That number is expected to grow to up to 300 by 2030.¹⁹

Key regional players like Vietnam, Malaysia, Australia, Singapore, Taiwan, and India seek to counter the PLAN's superiority in aircraft carriers (Beijing's so-called "strategic fist"), submarines, and growing number of sophisticated surface combatants and amphibious ships like the Type-055 and Type-075, respectively, with the asymmetric advantages in stealth and deterrence found in modern diesel-electric and AIP.²⁰ The best ASW tool, it is said, is another submarine. And in a region like the Indo-Pacific – where nationalist tensions are rife, a regional NATO-like security architecture absent, and where Canada sees increasing economic and political ties – having a submarine capability for both deployments and training Canada's surface fleet will be less a luxury and more of a requirement.

Finally, the proliferation of comparatively inexpensive anti-access/area denial (A2/AD) weapons systems, and now aerial drones, reiterate the importance of a submarine capability as the world's littoral regions (and beyond) become increasingly hostile to surface ships. Anti-ship ballistic and cruise missiles, like China's DF-21D and DF-26 or Russia's Bastion/Kalibr are becoming "more intelligent, faster, longer-range and with heavier payloads," representing "a new level of threat to surface ships" even when not operating too close to shore.²¹ These are not hypothetical threats. China's man-made islands in the South China Sea (ruled illegal in 2016 by The Hague) feature anti-ship and anti-air missiles like the YJ-12B, which aim to challenge the US carrier battle groups in which Canadian frigates operate.²² Such missiles could potentially disrupt global trade in key maritime transit points (e.g. Strait of Hormuz, Strait of

Malacca) where much of the 80 percent of all global goods, including 20 percent of the goods Canada trades outside of North America, move by ship annually (UNCTAD 2020; Expert Panel on the Social and Economic Value of Marine Shipping to Canada 2017). Submarines, with their missile strike, special forces insertion/retrieval, and ISR systems, will remain crucial to ensuring these vital sea lines of communication remain unimperiled by A2/AD systems.

Numerous modern wars, from the Falkland Islands, to the Persian Gulf and now the Black Sea showcase the devastating impact of anti-ship missiles on naval and commercial shipping. More than 80 states now possess such missiles, with 22 building their own, of which 17 are using imported designs.²³ The ease and danger of such weapons in the hands of non-state actors was amply demonstrated in 2006 when Hezbollah fired an Iranian-made variant of the Chinese Silkworm missile against an Israeli corvette, causing extensive damage and killing four of its crew.²⁴ China has since reportedly supplied its C-802A anti-ship missiles to Venezuela.²⁵ In such an environment, the ability of submarines like Canada's Victoria-class to perform ISR missions, launch missile strikes, and insert and retrieve special forces operators remains a vital function for the RCN and allied navies.



The geopolitical changes and maritime security threats Canada and its allies face are real. The days of the early post-Cold War 1990s when Canada was contemplating whether it even needed a submarine fleet are over. As the ongoing assault on Ukraine makes painfully clear, a Vladimir Putin-led revanchist Russia with the support of a rising global sea power in China upends decades of relative stability at sea. For Canada to guard its own waterways, those of its allies, and uphold the international commons, a renewed submarine capability is necessary.

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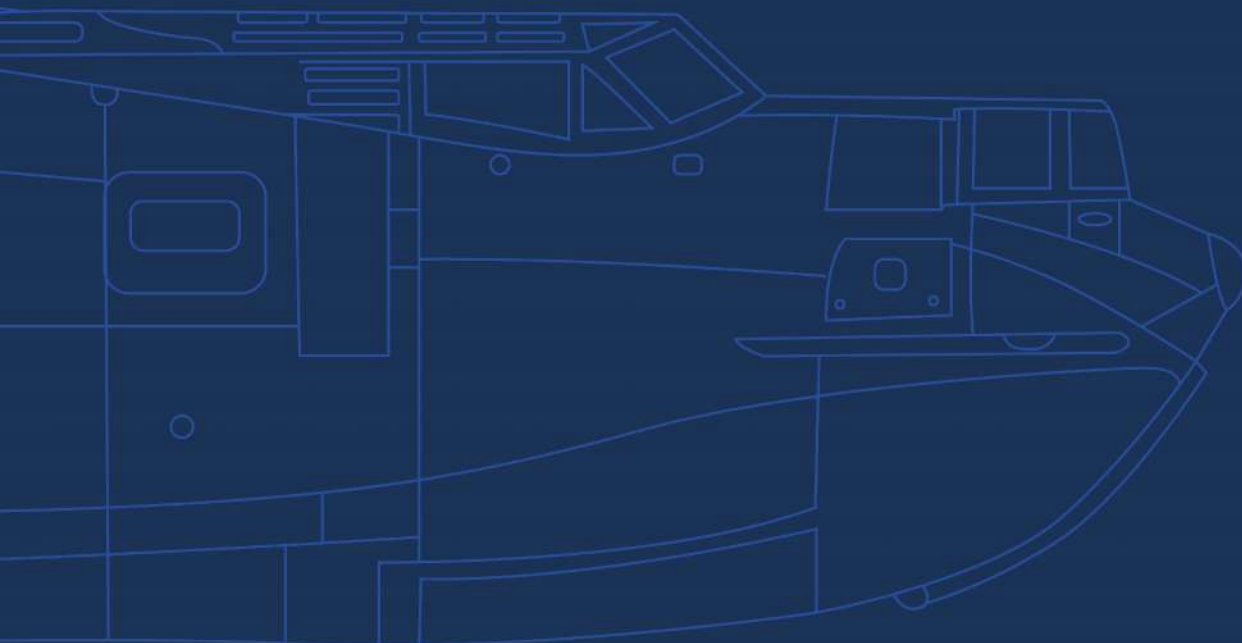
HMCS Victoria (Image: S1 Kendric Grasby, CAF Photo)



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Canadian Political Leadership and the Next Canadian Submarine

Rob Huebert, PhD

The greatest challenge facing Canada's submarine force comes not from its adversaries but from its elected leaders. The decision to defend Canada is always a political decision and must be understood as such. Canadian political leaders have not and will not understand modern seapower and, even worse, do not *want* to understand it. Often referred to as *saltwater blindness*, Canadian leaders have demonstrated since the Second World War that the protection of Canadian maritime security is not a priority.¹ This is particularly true when it comes to the Royal Canadian Navy's (RCN) submarine fleet. In spite of this, Canada has a long-term history of operating submarines, so how has this occurred and what does it mean?

Canadian Prime Ministers and their governments have been able to maintain their saltwater blindness because they are secure in the knowledge that the Americans will ultimately do what is necessary for the protection of North America. The knowledge that the Americans have had the world's most sophisticated and powerful submarine forces since the end of the Second World War has protected Canadian leaders from having to make serious decisions about the protection of Canada's undersea maritime regions.² This willful neglect is further facilitated by the lack of any meaningful political constituency within Canada that would compel Canadian political leaders to understand the need for the protection of Canada's maritime regions.

This has very important ramifications for those who must make the case for the existence of the Canadian submarine force and even more so for the those that need to drive the process to acquire replacements for the existing fleet. Canadian leaders are unlikely to be drawn into any meaningful understanding of the dynamics of the modern underwater warfare environment. Canadian leaders will not understand what is meant by SSBN, SSN or

SSGN. They will not have any interest in or about the ramifications of the expanded Chinese submarine construction program and why it matters that Beijing is determined to match the American fleet.

If anyone thinks that this is an exaggeration, just consider the current governments' refusal to even consider joining with the American, British, and Australians as Australia moves forward with decisions on its next generation of submarines through AUKUS.³ A consideration of the membership of the recently appointed Indo-Pacific Advisory Committee board that is tasked with developing an Indo-Pacific strategy is further evidence of this government lack of concern in this issue.⁴ Even though the maritime security of the region is acknowledged as one of the most important security challenges facing the democratic societies of the region, none of the members have expertise in the maritime security of the region.

Nevertheless, the Canadian Forces have been able to acquire and maintain submarines. The question that flows is that, given the existence of saltwater blindness among Canadian political leaders, how have Canadian navy leaders been able to ensure that Canada has kept its submarine fleet in existence? Equally important: what does this mean going forward as the Victoria-class reaches retirement age.

The problem is the lack of good information and evidence on understanding the process for outside observers. First the submarine community itself is notoriously secretive. Little information is open to the public on what naval planners think and how they proceed at both the operational and strategic level. There are a few sources of information, but these are limited.⁵ The service does not like to talk about itself, and it will not speak to its relationship with the political leadership. This is perfectly understandable but hinders the ability to understand both the strength and the challenges of the political-naval nexus that ultimately determines the nature of the submarine fleet, now and into the future.

As the same time the political elites in Canada are

developing a culture that emphasizes secrecy and control by the Prime Minister's Office (PMO).⁶ This is an ongoing element of Canadian politics, but many of Canada's most important policy scholars have been noting how the current Trudeau Government has moved to make the Canadian state even more secretive.⁷ A secretive submarine service and a secretive government means that it is very difficult to critically evaluate the nature of the political relationship.

A third issue is that there are not that many instances in which the Canadian government has gone through the process of buying submarines and this further inhibits our ability to provide a proper assessment of this process. Since the end of the Second World War there have been only three periods in which consideration of a class of submarine was undertaken: Oberon-class 1958-1965; SSN project

examination of how Canadian political elites understood the need for new submarines and how they proceeded.

Canada acquired its three Oberon-class submarines in the mid-1960. HMCS *Ojibwa* was commissioned in 1965, followed by HMCS *Onondaga* in 1967 and HMCS *Okanagan* in 1968. By the mid 1970s, the Department of Defence was considering replacing these ships.⁹ A study group was created to examine the possibility of procuring nuclear-powered submarines, this option was considered unlikely because of the cost. However, this changed when the Minister of National Defence for the Mulroney Government, Erik Nielsen, was briefed on the submarine replacement plan in 1985, he requested that the nuclear option be explored.¹⁰ This willingness to consider nuclear powered submarines surprised Navy officials, but they were

willing to pursue this option when it was offered. Eventually, this initiative led to the June 1987 announcement by the Mulroney Government Defence *White Paper* that:

Given the vast distances in the three ocean areas in which Canada requires maritime forces and the SSN's unlimited endurance and flexibility, the Government appear to have decided to acquire a fleet of nuclear-powered submarines to enhance the overall effectiveness of the Canadian navy.¹¹ The Government then proceeded to examine both a British and French design. However, before a final selection was made, the government rescinded its decision in the April 27, 1989, budget and

the nuclear submarine programme was eliminated.¹² This ultimately led back to the acquisition of four conventionally powered submarine of the Upholder-class from the UK in 1998.

The voyage of the *Polar Sea* was used by several Canadian decision-makers to justify the purchase of the submarines for use in Arctic Waters, even though



HMCS Onondaga, preserved as museum vessel (Image: Marco Verch)

1985-1989; and Upholder class 1996-2000.⁸ However, there has only been one instance in which there was robust political and public debate about the need for submarines for Canada. In 1985 the voyage of the USCGC *Polar Sea* through the Northwest Passage coincided with the Canadian Navy's search for the replacement of the Oberon-class submarines. This created a rare nexus of events that allows for an

the actual operational requirement for them would have been primarily in the Atlantic and Pacific Oceans. Most naval planners wanted the nuclear-powered submarines to counter the threat posed by Soviet submarines in the Atlantic and to a lesser degree in the Pacific. The operational need in the Arctic was perceived as secondary.¹³ As Rear-Admiral (ret.) Fred Crickard wrote: "The perception prevailed that the SSNs would be acquired exclusively for Arctic sovereignty. This image was enhanced by statements from Prime Minister Brian Mulroney, as well as Minister of External Affairs Joe Clark, despite repeated and public "clarification" by Minister of National Defence Perrin Beatty and senior naval officers. Unfortunately, their attempts to justify the acquisition in the context of a balanced maritime force to exercise sea control in Canada's three oceans went unheeded by the public."¹⁴

One defence official, who was involved in the early stages of the programme, explained that there were actually four main rationales for the acquisition of nuclear-powered vessels:

- to counter the threat posed by Soviet submarines carrying the SS-N-21 submarine launched cruise missile, operating off the coasts of Canada (primarily the Atlantic);
- the uncertainty in the international system;
- the enormous size of Canada's three ocean areas; and
- the need to have adequate surveillance in all of Canada's waters including the ice-covered arctic waters.¹⁵

Yet, if one examines the government's stated rationale for acquiring the nuclear submarines, the Arctic sovereignty considerations always received the primary public attention.¹⁶ The *1987 White Paper* also focused on the North. It explained that the decision to acquire nuclear submarines for the Canadian Navy had been made because DND officials were concerned about the ability of Soviet submarines to enter the Atlantic through the Arctic Ocean.

Over the past two decades, with the development of nuclear power, the Arctic has become an operating

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area for submarines. Deep channels through the Canadian Arctic offer a means of passing between the Arctic and Atlantic oceans. In a period of tension or war, Soviet submarines could seek to operate off the deep channels of the Canadian Archipelago to intercept Allied submarines entering the Arctic.¹⁷

While the 1987 *White Paper* stated that nuclear submarines would balance the Canadian armed forces' composition in all three oceans, public statements by several key decision-makers suggest that Arctic considerations were their main focus.

Minister for External Affairs Joe Clark testified before the Standing Committee on National Defence that in terms of Canadian sovereignty, the United States posed a greater threat than did the USSR, adding that:

One of the realities about nuclear-generated power submarines is that they can stay under ice. Their capacity under ice is much superior to anything else. One of the advantages of our having them—I am recasting arguments I have heard recently—is that possessing the capacity yourself makes it more likely that others who have that capacity will let you know what they are doing because if they do not know where you are they may run some risks to very expensive apparatus of their own.¹⁸

The "others" that Clark was referring to was the United States Navy. Their submarine service operates what is termed a water management scheme. When

one of their submarines operates near the water of an ally, they notify that nation that they have one of the submarines within a certain moving box. This prevents collisions and accidents.

Thus, by virtue of Canadian nuclear submarines' capabilities to operate in the North, the Americans would be required to develop a shared water space programme with Canada in the Arctic.¹⁹ Clark was essentially stating that the Americans would be prevented from operating in Canadian Arctic waters without informing Ottawa, if for no other reason than to avoid having one of their submarines collide with a Canadian vessel. Such concerns would force them to share information on their submarines' northern locations. It is telling that this would be the major concern of Clark. In effect, he was willing to support the purchase of nuclear submarines so that any suspected American submarines would be required to report itself. His concern was not about meeting the threat posed by the Soviet submarines.

In turn, Prime Minister Mulroney seemed to echo this logic when he stated that, "We are going to proceed with nuclear-powered submarines so we can fulfil our defence commitment and *affirm our sovereignty*."²⁰ [emphasis added] In the House of Commons, Mulroney directly linked the acquisition of the submarines to the protection of Canadian northern sovereignty. In response to a question posed by Bill Blakie (NDP) in December 1987, on the Arctic Cooperation Agreement, Mulroney provided a



HMS Tireless, a Trafalgar-class SSN at the North Pole (Photo: JOC Kevin Elliott, USN)

list of the government actions to protect Canadian sovereignty in the Arctic. He concluded by stating: "That is why the Government has made an important commitment with regard to nuclear submarines to ensure the exercise of sovereignty over Canada's North which has been so badly neglected by previous Governments."²¹

But as such statements were being made by Cabinet members, senior military officials were offering a different story. At a conference on Nordic Arctic Security in the spring of 1988, Rear Admiral John Anderson, the head of the nuclear submarine acquisition programme, stated: "The suggestion by some detractors that Canadian SSNs would be used "to stop United States submarines from using the Northwest Passage" is absurd. Canadian SSNs will respond to potentially hostile submarines; United States submarines can hardly be placed in that category."

It is equally ludicrous to suppose that allied submarines will be sent out into ocean areas to listen for other allied submarines. It doesn't happen now, and Canada's acquisition of nuclear propulsion won't change things.

Waterspace management will provide a safe and efficient way of managing our sub-surface northern affairs.²² This is about as close as a direct contradiction of a senior military official over a senior political leader as one can find. It is of course unthinkable that a serving officer today would be given such a latitude of thought.

Defence Minister Perrin Beatty made public statements supporting both positions. In a statement to reporters, he defended the decision to purchase the nuclear submarines by stating that: "Somebody's navy will be in our Arctic, whether it's Soviet, American or Canadian ... I want to make sure it's Canadian."²³ Embedded in his comment remains the concern over the presence of American submarines.

Yet, in other interviews he also made it clear that the submarines were not primarily for the Arctic. In an interview he stated, that "[i]f we were simply interested in surveillance, submarines would be a bad investment ... They will enhance sovereignty, but that's not why we're buying them. It's for security."²⁴ In the House of Commons, Beatty declared that it was a falsehood to state that the submarines were "simply

to protect our sovereignty in the Arctic."²⁵ He explained that only nuclear-powered submarines could go into the Arctic because of the unique problems and dangers created by the ice. Taken at face value, it is evident that Clark, Mulroney, and Beatty all had a different understanding of why nuclear-powered submarines were necessary. Of course, is it also possible that the differences in their perspective represented a calculated decision to reach different constituencies to build as wide of support as possible for the decision to buy the submarines.

Reports emerged that Beatty and Fowler used the sovereignty arguments to achieve Cabinet's agreement to pursue the acquisition of the nuclear submarine.²⁶ It has been indicated that Clark was initially strongly opposed to the proposal to buy the nuclear submarines, but that Beatty and Fowler used Clark's previous arguments to increase Canadian presence in the Arctic to justify the purchase. In doing so, they were able to pre-empt Clark's opposition.²⁷

The Government ultimately decided that it would not purchase nuclear powered submarines in 1989. In part, the decision was based on the collapse of the Cold War and the redirection of international tensions. But an equally important element of the decision was the perception that the submarines had become too expensive in a time when the government had made deficit redirection its primary policy orientation. By the time the nuclear-powered submarines were cancelled in the spring of 1989 there was almost no mention of the protection of Canadian Arctic sovereignty, except for the closing comments of the new Minister of National Defence, Bill McKnight, who lamented, "there are better ways of defending northern sovereignty and unfortunately we cannot afford those ways. Canadian sovereignty in the Arctic will remain as it has been for 122 years."²⁸

He ended with the argument saying that that the loss of the submarines would be more in terms of sovereignty than security. Arctic sovereignty concerns were used as one of the primary means of justifying the programme. Evidence suggests that such a concern, though important, was secondary to DND officials.

Lessons to Consider

The above case comes close to telling the full story. For example, there may be a political story

behind the decision to purchase the number of 10-12 submarines. It cannot be verified but the decision to select this number may have emanated from Minister of Defence Erik Nielsen. Suggestions have been made that the navy officials tasked with developing the Oberon replacement had first approached him with the recommendation of six nuclear powered submarines. This was based on the evaluation that such a number would meet the threat of Soviet submarines coming through the GIUK gap. Six were assumed to be the number needed to keep three submarines on station at any one time. Nielsen was said to suggest that boats must be on station in the Pacific and in the Arctic, and it was this argument that resulted in a doubling of the number first purposed. The problem is that with such an increase the infrastructure needed substantially increased as well, resulting in a much higher overall cost. If this is true, then the effort to “add” on the costs of being in the Arctic and Pacific may have contributed to making the overall project too expensive in the long run.

Had the decision been made to proceed with the recommendation of acquiring 10 to 12 submarines, it is difficult to see the Navy being able to sustain the rest of its surface fleet in any meaningful way. Given the cuts that DND had to endure in the 1990s, it is doubtful that approval would have been given to proceed with the Halifax class. Thus, the decision made by Nielsen to buy 10-12 nuclear powered submarines would have decided the future of the entire Canadian Navy for as long as the submarines remained in service. But all this is based on the assumption that this is how that decision was actually made. There is a need for further research to determine if that was actually the case.

What can be accepted with a higher degree of

certainty is as follows. First, there was no indication of any strategic understanding of the requirements of seapower in the calculations of Nielsen, Clark, Mulroney, and Beatty. At no point in the open-source material is there any sign of an understanding of the role of the submarine in modern warfare. This was the time in which the Americans were developing the Forward Maritime Strategy with the intention of taking the fight to the Soviet Navy.²⁹ Many were very critical of the strategy, but the American senior naval leadership had come to the conclusion that such an approach was the best means of defeating Soviet naval power.

At the same time, the USSR was developing its Oscar-class SSGNs. Most have suggested that this was designed to defeat American carrier battle groups – which were central to the Forward Maritime strategy.³⁰ Others have suggested that the Oscars were designed to close on American cities and launch an undetected cruise missile attack. Regardless of the actual intent of the USSR leadership, the Forward Maritime Strategy and the new class of Soviet SSGNs demonstrates the dynamic and interactive nature of naval warfare of the time.

Nowhere is there any indication that this was understood by any of the Canadian political leaders. Had the Cold War not ended, the addition of 10-12 Canadian nuclear powered submarines could have played a very important role in North American maritime security. The Americans would have wanted to have them support the USN as it moved north under the terms of the Forward Maritime Strategy, and the Soviets would have had to develop plans to counter them. Thus, Canada would have been thrust into the core dynamic of the most important element of seapower at the time. Nowhere is there an



USCG Polar Sea (Image: Petty Officer 3rd Class Kevin Neff, USCG Photo)

indication that this was understood by any Canadian political elite.

What was understood by Canadian political leaders at the time was that there was a political problem with the Americans regarding Arctic sovereignty. The newly elected Mulroney Government had come to power on the basis of improving relations with the Americans. This was to allow the government to proceed with negotiations to improve economic relations by facilitating negotiations for a free trade agreement. But the government could not do this unless it was able to convince the Canadian public that it was not beholden to the US. When the USCGC *Polar Sea* went through the Northwest Passage without asking permission in 1985, this threatened many of the Mulroney government's core political objectives. Only by convincing themselves that by submarines operating in the Arctic offered political benefits did Canadian political leaders understand a utility in buying submarines. But at no point beyond understanding the basics of the requirement of the underwater management schemes that governed the passage of NATO allied submarines was there an understanding of how a Canadian fleet of nuclear-powered submarines were going to “defend” Canadian Arctic sovereignty. It was on this basis that the key political leaders were defending the process and presumably understand the need for the submarines.

So, what insights does this provide as the next submarines are being considered? First the process will be dominated by politics and misunderstandings. This will be very frustrating for any naval planner who is hoping or expecting that the leaders of Canada will make informed decision for the security of Canadians. It did not happen the last time. Current Canadian defence planners should not expect it to occur now. Instead, defence planners need to realize

that they need to be attuned to the political imperative of the Canadian Government. This means that the process will not follow a logical evidence-based path. It will be driven by the political objectives of the Government of the day.

Furthermore, the example of the process regarding the potential purchase of the 10-12 nuclear submarines was also very strongly affected by the impact of outside events. Had the USCGC *Polar Sea* not sailed through the Northwest Passage in 1985, it is highly unlikely that Clark or Nielsen would have even considered the possibility of buying SSNs to “protect” Canadian Arctic Sovereignty. The impact of the current resumption of fighting in Ukraine has focused the attention of current Canadian leaders on the need to finally buy the F-35s after a very long period of avoidance. Similarly, a war over Taiwan would undoubtedly showcase the importance of submarines in modern naval warfare. Such an event would likely prod even the most reluctant Canadian Government to get serious about the purchase of new submarines.

This means that the need to purchase submarines will proceed as it becomes politically expedient for the government. Just as the move to replace the CF-18 has been more the result of politics than strategy. Canadian Navy planners need to understand the processes that have ultimately driven the Government to make these decisions to better understand what is necessary before the submarine replacement program can proceed. The process is political, not strategic, and this will ultimately determine if the current submarines are replaced and if so by what and how many.

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¹ House of Commons, Standing Committee on National Defence, *The Readiness of Canada's Naval Forces: Report of the Standing Committee on National Defence*, 42nd Parliament, 1st session (June 2017) 78.

² C.P. Stacey, *Canada and the Age of Conflict: a History of Canadian External Policies* (Toronto: University of Toronto Press, 1977).

³ Paul Mitchell, "Canada's exclusion from the AUKUS security pact reveals a failing national defence policy," *National Post* (September 24, 2021).

⁴ Government of Canada, Global Affairs, Members of Canada's Indo-Pacific Advisory Committee (June 6, 2022).

⁵ These include *Vanguard*, *Canadian Naval Review* and the Naval Association of Canada NAC.

⁶ Kathryn May, "All Powerful PMO, mistrust "destroying the public service: Paul Tellier," *Policy Options* (May 30, 2022) and Mel Cappe, Yan Campagnolo, "Cabinet secrecy is essential, but should not be absolute," *Policy Options* (May 24, 2022).

⁷ Donald Savoie, *Democracy in Canada: The Disintegration of Our Institutions* (Montreal; McGill-Queen's University Press, 2019).

⁸ Julie Ferguson, *Through a Canadian Periscope: the Story of the Canadian Submarine Service*, Second edition (Toronto: Dundurn, 2014), 288-371.

⁹ Confidential interview with retired DND official.

¹⁰ Several DND officials have confirmed Nielsen's action, but all have requested anonymity. Additionally, no documented sources can be found so one must approach the recounting of these events with some caution.

¹¹ DND, *Challenge and Commitment*, 52.

¹² Paul Koring, "Tory Defence Promises Wiped Out," *Globe and Mail* (April 28, 1989).

¹³ There is substantial literature on the nuclear submarine acquisition programme. Most of the articles examined the technical and/or strategic aspects of the submarines. Nevertheless, it is possible to determine that the dominant view among retired officers was that the operational purpose of the submarines was more oriented to the Pacific and Atlantic than to the Arctic. While they do not discount the need to have submarines with under ice capability, the speed and endurance of the nuclear-powered vessels is their main concern. See: Fred Crickard, "Canada and Nuclear Submarines: A New Submarine for Canada," *Wings News Magazine* Special Edition (1986); Fred Crickard, "Nuclear-Fuelled Submarine: The Strategic Rationale," *Canadian Defence Quarterly* 17 (Winter 1987-88); Peter Haydon, "The Future of the Canadian Navy," *Canadian Defence Quarterly* (Winter 1990); and Mike Young, "Submarines for the Canadian Maritime Force," *Canadian Defence Quarterly* 16 (Summer 1986).

¹⁴ Fred Crickard, "The Rise and Fall of the Three-Ocean Concept," *Canada's Navy Annual* Issue #4 (1989/90), 11.

¹⁵ Confidential Phone Interview.

¹⁶ For perhaps the best strategic analysis of the Arctic issues see: Peter Haydon, *The Strategic Importance of the Arctic - Understanding the Military Issues* (Ottawa: Directorate of Strategic Policy Planning, Department of National Defence, March 1987).

¹⁷ DND, *Challenge and Commitment*, 50.

¹⁸ Canada, House of Commons, SCND, *Minutes of Proceedings and Evidence*, issue #10 (April 14, 1988, .10), 12-13.

¹⁹ A detailed examination of the issues created by water space management issues is provided in Joseph Jockel,

"The US Navy, Maritime Command, and the Arctic," *Canadian Defence Quarterly* (December 1989).

²⁰ Fred Crickard, "The Rise and Fall of the Three-Ocean Concept," 11.

²¹ House of Commons, *Debates* (December 8, 1987), 11594.

²² Rear Admiral John Anderson, "Canadian Perspective on Arctic Security Issues," paper presented at Colloquium on Nordic Arctic Security, Centre for International Affairs, Harvard University (March 17, 1988), 22-23.

²³ "Ottawa Puts \$200 Billion Into Defence," *Winnipeg Free Press* (June 6, 1987).

²⁴ "Nuclear Submarines to Enable Canada to Fight Modern War, Minister Says," *Globe and Mail* (June 18, 1987).

²⁵ Canada, House of Commons, *Debates* (June 9, 1988), 16282.

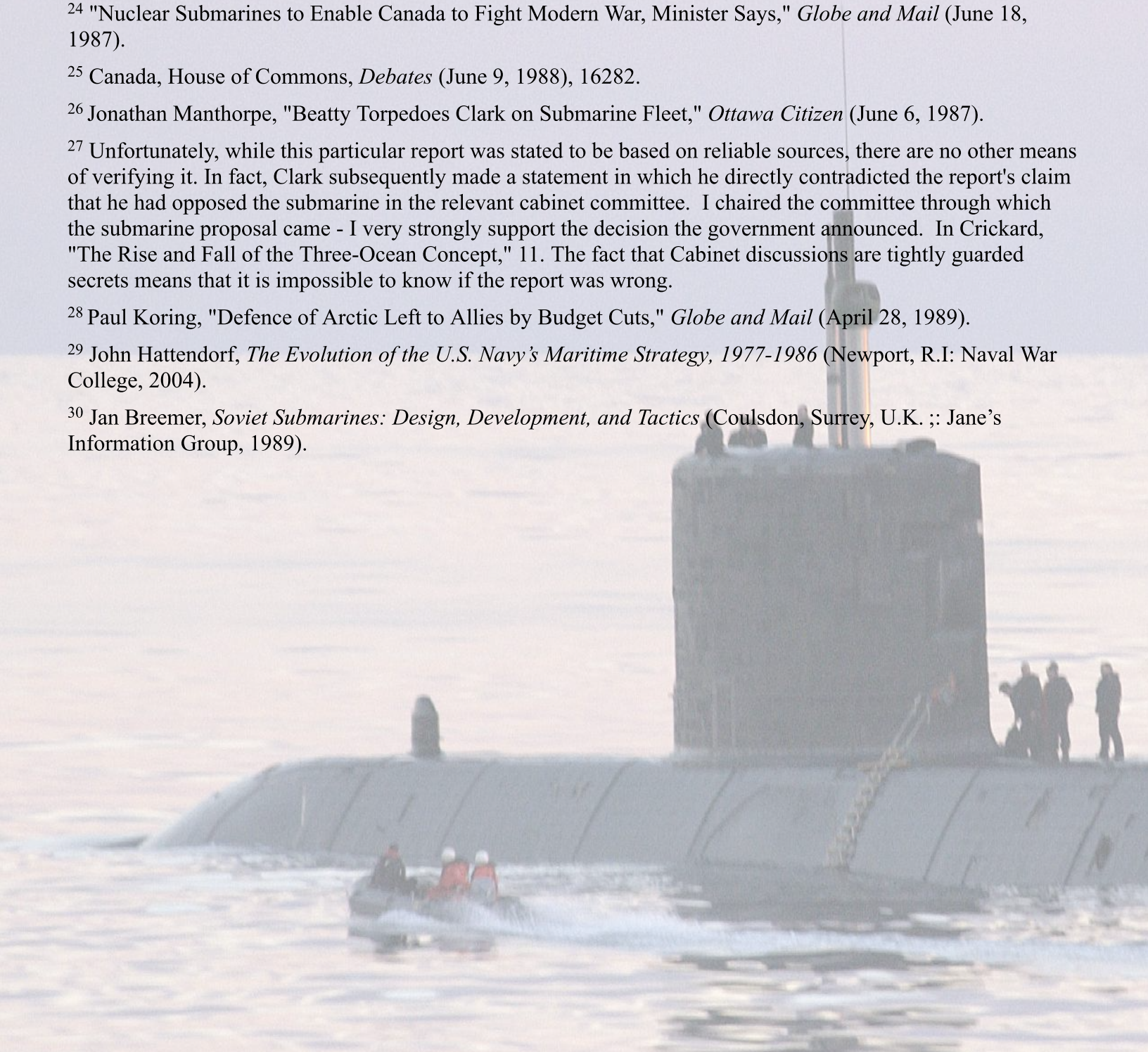
²⁶ Jonathan Manthorpe, "Beatty Torpedoes Clark on Submarine Fleet," *Ottawa Citizen* (June 6, 1987).

²⁷ Unfortunately, while this particular report was stated to be based on reliable sources, there are no other means of verifying it. In fact, Clark subsequently made a statement in which he directly contradicted the report's claim that he had opposed the submarine in the relevant cabinet committee. I chaired the committee through which the submarine proposal came - I very strongly support the decision the government announced. In Crickard, "The Rise and Fall of the Three-Ocean Concept," 11. The fact that Cabinet discussions are tightly guarded secrets means that it is impossible to know if the report was wrong.

²⁸ Paul Koring, "Defence of Arctic Left to Allies by Budget Cuts," *Globe and Mail* (April 28, 1989).

²⁹ John Hattendorf, *The Evolution of the U.S. Navy's Maritime Strategy, 1977-1986* (Newport, R.I: Naval War College, 2004).

³⁰ Jan Breemer, *Soviet Submarines: Design, Development, and Tactics* (Coulsdon, Surrey, U.K. :; Jane's Information Group, 1989).



HMCS WINDSOR using a Zodiac during Canadian Fleet Operations. (Image: Sgt Roxanne Clowe, CAF Photo)

Canada's Critical Submarine Requirements

Commodore [Ret'd] Jamie Clark

Today nearly 90% of all traded goods are carried across the world's oceans, over 11 billion tons a year or roughly 1.5 tons for every person on the planet. The world's shipping lanes are the arteries of an integrated global economy connecting the world like at no other time in history. Canada's economy, prosperity, and very way of life are inextricably tied to the sea.

Canadians are rightly proud of our nation's role in helping to shape today's world and the role we play in continuing to protect those achievements while helping build a better future. However, the freedom and prosperity enjoyed today is not guaranteed tomorrow.

Each and every day, the men and women of Canada's Armed Forces protect Canada and promote peace and stability the world over. Our navy, working alongside allies and partners around the world, helps protect and preserve the free, unencumbered use of the sea. Submarines are critical to this effort. Their stealth, persistence, and lethality, bring capabilities and strategic options to a government that no other platform can. When it comes to safeguarding the arteries of our integrated global economy, submarines are the ultimate guarantor.

In recent years the growing complexity of the world's security situation and the emergence of new, real and 'unique-to-Canada' threats has given submarines and their unique combination of capabilities a new relevance. In this tremendously complex security environment, for Canada to actively participate in its own defence, it must be able to contribute integrated, interoperable, and interchangeably with our American allies along all three coasts, above, on, and beneath the ocean's surface.

North America's most difficult threats, those from

the sea, those meant to circumvent NORAD's northward facing history, are managed best by submarines. The return to a bygone era of strategic competition between superpowers is a competition where Canada is a neighbour, an ally, a geographic buffer, and given our integrated infrastructure, seen by adversaries as an extension of the United States making us, at least in their strategies, a valid military target. This modern great power competition is a competition where victory looks like the status quo and where the pernicious effect of defeat will fundamentally change our way of life.

Since the 16th of February, 1815 when the United States Senate ratified the treaty of Ghent, ending the War of 1812, Canada's forces have only fought abroad. In the First and Second World Wars, Korea, Afghanistan and a myriad of peacekeeping operations, our ability to get from Canada to where we were needed was never in question. Shifts in geopolitics and technology mean Canada can no longer rely on expeditionary forces to contain hostilities in far off lands. Over the past two decades, while we executed that exact strategy, concentrating on the capabilities, training, and tactics we needed to fight in failed and failing states, competitors invested, trained, and advanced their military capabilities. We remained focused on forward operations – the way we always have. They focused on undermining our previously uncontested ability to move within, and deploy from, North America. Advanced technology, substantive investment, and well-meaning treaties like Open Skies allowed competitors to target our most critical infrastructure. Canada and the United States are no longer sanctuaries, we are not immune to conventional attack – competitors have solved deterrence by geography. With that, our ability to conduct operations far from home is no longer a guarantee, our ability to keep Canada safe solely by fighting abroad is gone. Canada's ability to deploy forces beyond our own borders can and will be contested by Russia or China with weapons systems

that have already been used operationally and to devastating effect in Syria and Ukraine.

Paradoxically, the threat to Canadian soil comes as no surprise, and a complete surprise, to the average Canadian. Since August 29, 1949, when the Soviet Union detonated its first nuclear bomb, Canadians have lived under the dark cloud of nuclear annihilation. However, it was known that a nuclear attack on North America would be met in kind. Mutually Assured Destruction kept a fragile peace. What has changed is that the country is now vulnerable to attacks below the nuclear threshold – from over the pole as well as from ships and submarines in the Atlantic, Arctic, and Pacific Oceans. The threat axis is all around.

An attack on North America is no longer a desperate, suicidal act but rather a valid strategy designed to erode public will, fracture alliances,

undermine power projection capability and create economic chaos. This is a widely publicized component of Russia's strategic thought.

To remain a relevant ally and partner, to continue to prosper from economic relationships, the foundation of which is our shared responsibility for North American security, Canada must modernize its defences, including a robust RCN – on the surface and below. We must protect our ability to operate when and where we choose. Competitors and their current and emerging military capabilities have pushed Canada's national psyche towards the base of Maslow's hierarchy. Where we once worried about international esteem and exporting values, we must now turn to the basic needs of safety and security.

As a result, Canada and the United States have embarked on a long overdue effort to modernize the North American Aerospace Defense Command



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(NORAD) a critical and necessary part of our shared defence. However, while absolutely necessary, the ability of competitors to strike from any point on the compass means that a robust north-looking defence network will not, in and of itself, be sufficient. Without a technologically advanced, highly capable navy, including a leading edge submarine fleet, Canada risks creating a 21st century Maginot Line, including its false sense of security.

The submarine force which Canada needs must be based on, and evaluated by, the three core submarine capabilities: stealth, persistence, and lethality. After safety, nothing is more important to a submarine than stealth. Given the relatively slow and limited duration of diesel submarine sprint ability, not being detected – stealth – is survivability. Stealth not only includes quiet propulsion systems and ancillary machinery, but also effective control systems and autopilots to keep depth in all types of weather to minimize control surface transients. More important is the ability to do this at periscope depth. To avoid broaching or exposing ‘too much’ mast and providing a non-acoustic detection opportunity to waiting radars or watching eyes. World leading sensors and prediction tools are critical to understand the acoustic and electro-magnetic environments, minimal radar cross sections for all masts, periscopes that can make sense of the surrounding environment quickly, by day and night, and electrical generation, distribution and storage capabilities that minimize the requirement to run generators and risk all types of counter-detection. Stealth starts on the drawing board but is only fully realized when a well-designed, well-built, and well-maintained submarine is in the hands of a well-trained crew. Canada’s next submarine must have the stealth characteristics that provide acoustic advantage against the world’s quietest submarines. This includes the sustained investment needed for through-life acoustic husbandry and an increasingly operational mindset of submarine maintainers.

Persistence is equally vital. Submarines surveil large areas of ocean and observe visually, electronically, or acoustically while remaining undetected. Where aircraft can loiter for hours, a ship for days, submarines can loiter and observe – alone and undetected – for weeks on end. When no one knows you are there, they don’t mask their behaviour – you see truth. Submarines carry the fuel, rations,

spare parts, and technical competencies needed for extended, unsupported missions.

Projecting this capability forward creates its own considerations. For Canadian submarines, almost everywhere is far, even domestic areas of operation. As an example: Halifax to Faslane is about 2,400 nm. Honolulu is about the same distance from Victoria. Halifax to Resolute Bay is 300 nm further than both of these far more hospitable destinations. What used to be considered lengthy foreign deployments will be, for Arctic capable submarines, routine domestic operations. Any future submarine program with Arctic aspirations must build submarines with the range to get to the Arctic, operate for a reasonable period of time, and return home. To put that in perspective, at a ‘not-very-covert’ transit speed of 7.5 knots it would take 30 days just in transit time for a trip from Halifax to Resolute Bay and back. Alternatively, any RCN Arctic facility could – perhaps should – have the ability to support submarines – an approach that would open the doors to a wider range of design options and likely lower overall program cost.

A submarine’s lethal capability is unmatched by anything else at sea. A single heavyweight torpedo can destroy a ship or enemy submarine. In an age of small navies, small fleets and tight defence budgets, the risk presented by a single submarine’s absence from imagery can change how governments choose to employ maritime force. One need only consider the retreat of the Argentinian navy to its territorial waters after HMS *Conqueror* sunk the cruiser *Belgrano* during the Falklands War 40 years ago last month. As Admiral Sandy Woodward, a former submariner, noted in his book *100 Days*: "What no one knew then was that Christopher Wreford-Brown’s [CO of HMS *Conqueror*] old Mark-8 torpedoes, appropriately as old in design as the *Belgrano* herself, had sent the navy of Argentina home for good. Unwittingly we had achieved at least half of what we had set out to do from those days at Ascension: we had made the Argentinians send out their fleet and a single sinking by a British SSN had then defeated it. We would never see any of their big warships again."¹

The combination of stealth, persistence, and lethality are just as attractive – if not more so – to our competitors. Submarines were a persistent focus of the Soviet Navy. Former Admiral of the Fleet of the

Russian submarine Severodvinsk
(Image: Wikicommons)



Soviet Union and Commander-in-Chief of the Soviet Navy, Admiral Sergey Gorshkov noted in his book *The Sea Power of The State* that submarine construction “made possible in a very short time to increase sharply the strike possibilities of our fleet, to form a considerable counter-balance to the main forces of the fleet of our enemy.”²

Today, like 40 years ago, submarines carry an incredible anti-surface and anti-submarine punch. What has changed in the intervening years is the pairing of cruise missile technology with submarine persistence and stealth, creating a new dimension to submarine lethality. No longer are a submarines' conventional weapons limited to destroying ships and other submarines – critical infrastructure, economic centers, transportation nodes and a host of other targets ashore are all potential targets for a cruise missile armed submarine.

The most modern Russian cruise missile armed submarines are the Severodvinsk-class. In 2019, Pentagon officials told the news program “60 Minutes” that the *Severodvinsk*, with its advanced quieting technology, had sailed into the Atlantic Ocean in 2018 and remained undetected for weeks at a time. A modified Severodvinsk entered service last year and is even quieter. A *Business Insider* article from 2021 interviewed both the Commander of the 2nd Fleet and the Commander of US Naval Submarine Forces on the threat posed by today's Russian submarines. Commander Second Fleet, VAdm Andrew Lewis commented, “our ships can no longer expect to operate in a safe haven on the East

Coast or merely cross the Atlantic unhindered.”³ VAdm Daryl Caudle, Commander US Submarine Forces expressed a similar concern stating: “It is pretty well known now that our homeland is no longer a sanctuary, so we have to be prepared here to conduct high-end combat operations in local waters.”⁴

If the RCN is going to be able to participate in future conflict, it must be prepared for ASW action in the approaches to Halifax, the Strait of Juan de Fuca, and the Canadian Arctic. No other platform is better suited to detect, track, classify and engage a submarine than another submarine. If the RCN is to be a relevant future force, it must have submarines.

A future submarine force is needed not just to facilitate access to the high seas for the RCN, not just to conduct traditional submarine missions, but rather, a future Canadian submarine will be part of the very fabric of a continental defence network, needed to protect Canadians and Canada's sovereign territory against missile strikes from the sea. As General Glenn VanHerck, Commander of NORAD and USNORTHCOM stated in his March 8th written testimony to the House Armed Services Committee: “Russia has fielded the first two of their nine planned Severodvinsk-class guided missile submarines, which are designed to deploy undetected within cruise missile range of our coastlines to threaten critical infrastructure during an escalating crisis. This challenge will be compounded in the next few years as the Russian Navy adds the Tsirkon hypersonic cruise missile to the Severodvinsk's arsenal.”⁵

Competitors understand the importance of submarines and how these can be paired with emerging missile technology to keep Canada, the United States and, indeed, NATO out of regional conflicts. As Canada reinvests in the navy for the threats of the future, the nation would do well to invest in the asymmetric capabilities that will keep competitors away from its shores. To this end, submarines remain the best platform to execute the entirety of the ASW kill-chain.

A few years ago, I was privileged to attend a yearlong international program at the United States Naval War College. Our professors consistently hammered home the value of leaning on the great masters. While the writings of Sun-Tzu, Clausewitz, Jomini, Mahan, Corbett and others seem dated to many, they just have a way of bringing clarity to the most challenging military problems. Oddly enough, the writings of a Prussian Army General seem exceedingly appropriate to a Canadian submarine acquisition, and to the Canadian national psyche – especially in dangerous times such as today. In the opening paragraphs of the opening chapter of the opening book of *On War*, Clausewitz remarked:

"Kindhearted people might of course think there was some ingenious way to disarm or defeat without too much bloodshed, and might imagine this is the true goal of the art of war. Pleasant as it sounds, it is a fallacy that must be exposed: war is such a dangerous business that the mistakes which come from kindness are the very worst. The maximum use of force is in no way incompatible with the simultaneous use of intellect. If one side uses force without compunction, undeterred by the bloodshed it involves, while the other side refrains, the first will gain the upper hand."⁶

In the past few months, Canada has witnessed the world return to the brutality of war. We have seen competitors stop at nothing to achieve their aims. In this new world, the nation must provide its soldiers, sailors, and aviators with the tools they need to prevail in the brutality of war. As the United State's

first president said during his first address to both Houses of Congress "To be prepared for war is one of the most effectual means of preserving peace."⁷ Today's world is too dangerous not to be well prepared.

In a Mahanian context, submarines remain the ultimate guarantor of trade, the protector of the great global commons. In today's security environment where adversaries hold our power generation and distribution capabilities transportation hubs, economic centres, force projection capabilities, and other critical infrastructure is at risk every day. Submarines are both our greatest deterrent and our last line of defence. They are the best, if not only, way to defend against a devastating adversary submarine capability that, without submarines of our own, may only be unmasked when they launch their highly capable weapons systems into the heart of North America.

Canada's next defence policy must rapidly adjust to a world that is armed with the most sophisticated weapons yet, at the same time, a world that has reverted to the aggressive behaviors and failed diplomacy of years gone by. As Canada writes its new defence policy, it is essential to commit the funding and resources needed to rapidly rebuild its defences to keep Canadians safe. These investments must include the tools necessary to not only understand what is happening above, on, and beneath our maritime approaches but the ability to act decisively. This only comes with a continued submarine capability.

Jamie Clarke, a native of Sarnia Ontario, is a retired RCN Commodore, the grandson of a First World War Army Officer and a third generation Canadian Armed Forces member. During his 34 and half years in the RCN, he saw service during the first Gulf War, specialized in navigation and eventually saw the light and volunteered for the Submarine Service. In the fall of 2003, Jamie became the first Canadian and only second foreign student on the United States Navy's Submarine Perspective Commanding Officer's course. In the fall of 2004, he became the first Canadian to attend the Norwegian Submarine Command Course after which, he was fortunate to enjoy an extended, split command tour that saw him command both VICTORIA and CORNER BROOK. His other commands include the Halifax Class frigate ST. JOHN's, the Fourth Maritime Operations Group and the Canadian Submarine Force. His final posting in the RCN was as the Deputy Director of Strategy, Policy and Plans at NORAD Headquarters in Colorado Springs. A 2008 graduate of the Canadian Forces College and a 2018 graduate of the United States Naval War College's international Naval Command College, Jamie also holds an undergraduate degree from the University of Western Ontario where he majored in mathematics and Master's degrees from the University of New Brunswick (engineering) and the Royal Military College of Canada (Defence Studies).

Notes

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HMCS Chicoutimi Faslane, Scotland (Image: Cplc Paul MacGregor, CAF Photo)

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The Modern Threat Environment and Canada's Future Submarine

Rear Admiral Chris Robinson

Canada is first and foremost a maritime nation – with three expansive oceans and a long history of excellence on the seas. I would go one step further and suggest that this is not simply because Canada borders on three oceans with the world's longest coastline but rather, we are a maritime nation because of our trade with the world. As an example, Leadmark 2050 notes that one third of Canadian Tire's entire inventory is at sea in containers at any given moment.

Future adversaries will likely present a range of conventional, irregular, and asymmetric threats in the maritime space. For many potential adversaries, mines and submarines will remain the most effective platform to deny access, given their ease of acquisition and the significant resources and level of effort required to counter such weapons. These benefits accrue whether the underwater weapons are actively employed or not and we have seen multiple examples of this occurring over the last few decades, including in the Black Sea in recent days. Moreover, the coming decades will also see the widespread adoption and deployments of remotely piloted and autonomous vehicles, which give more options to an adversary, and thus further complicates the underwater battle space. Moreover, for friendly forces, such vehicles will extend both the sight and reach of a task group, performing intelligence, surveillance, and reconnaissance (ISR) tasks in high-risk environments, remotely targeting weapons, and conducting battle damage assessments. However,

while autonomous vehicles will become increasingly useful for “dull, dirty, and dangerous” missions, crewed vehicles will remain indispensable for complex situations requiring decentralized command and independent decision-making, for the foreseeable future. Weapons release authority in particular is exceptionally unlikely to be delegated to autonomous systems within the foreseeable future.

Regardless of the means at their disposal, future adversaries can be expected to deliberately mask their actions in the clutter and congestion of the littorals, exploiting the natural environment to reduce the effectiveness of our networks, sensors, and weapons. Littoral waters present significant environmental and propagation challenges for traditional acoustic sensors, notwithstanding the considerable advances in signal processing within modern sonar systems. The littoral demands even more technologically advanced solutions such as multi-static sonar configurations and advanced signal processing and data fusion techniques.

The RCN is evolving its underwater warfare capability using a “system of systems” approach. This is being achieved through improved technologies to increase domain awareness and provide improved effectors, and an evolved self-defence capability. Our expanded capability needs to integrate all aspects of the underwater domain, fusing data from a variety of sensors, platforms, weapons, and networks to increase our ability to exercise sea control/sea denial. This necessarily drives the need for crewed submarines.

This paper represents personal opinion, written as a subject matter expert. RAdm Robinson has no links to the Canadian Patrol Submarine Project, which is in the early stages of examining the capabilities required for Canada's next generation submarine. Accordingly, nothing in this paper should be construed as official project information nor indicative of any future decisions to be made by the proper authorities.

Background

Strong, Secure, Engaged (SSE) affirmed that the RCN is a Blue Water Navy which requires a balanced mix of platforms, including submarines, surface combatants, support ships, and patrol vessels, in sufficient quantities to meet our domestic and international needs.

Canada's submarines are a key element of the system-of-systems approach to maritime domain awareness (MDA). Working together with surface, air, and space surveillance capabilities, submarines play an important role in sovereignty operations and continental defence today – and are anticipated to continue to do so and perhaps even grow in significance.

Submarines contribute to protecting Canadian sovereignty by providing presence, surveillance, and response capabilities that enable a deterrent effect to counter potential adversaries or trespassers into Canadian waters. Offering a robust suite of surface, air (Electronic Warfare), and sub-surface surveillance capabilities, submarines are a key element of the CAF system-of-systems approach to sub-surface MDA/maritime undersea surveillance and response – an aspect of sovereignty and continental defence that has seized NORAD and national attention for the uniquely stealthy, persistent, and lethal capability set they provide. Through key contributions to MDA in Canada's territorial waters and approaches and an unparalleled response capability (i.e. heavy-weight torpedoes), Canada's submarines advance core continental defence objectives under the NORAD Agreement and the CANUS Combined Defense Plan. The criticality of a fulsome Canadian MDA contribution is emphasized by the fact that Canadian Areas of Responsibility lie along the great circle route between either Europe or the Indo-Pacific and major North American ports which increases the likelihood of a foreign sub-surface presence off our shores. Given that submarine technology is being exploited by non-state actors, like Caribbean drug cartels, the significance of sub-surface MDA and maritime undersea surveillance is an important capability to retain and grow.

The Arctic

Canadian naval assets, including submarines, have operated north of 60N for decades. Depending on the time of year and ice conditions, the Victoria-class has the capability to operate in the Canadian Arctic and the chokepoints of the Northwest Passage. Given the climate change driven trends of rapidly receding ice coverage in the Arctic, the potential areas for operating Canadian submarines will increase significantly.

Operating in the Arctic can be divided into under-ice operations and patrols in the vicinity of the Marginal Ice Zone (MIZ). Each has its unique challenges. Currently sustained operations under ice are the domain of nuclear-powered submarines but AIP submarines are certainly capable of operating under the ice cap as well. Operating in the north, even in the approaches to the MIZ, brings with it significantly different operating conditions than in southern waters. Having personally operated in the MIZ, these three issues stand out to me as the three main challenges: navigation; strict environmental stewardship; and long distances from support.

Navigation concerns me because, with the sparse bottom soundings available, and generally (from a submarine perspective) shallow waters make iceberg avoidance an interesting sport. This can and will be mitigated by High Frequency navigation sonars, reliable inertial navigation systems, and regular operations in the area in order to improve the crews' familiarity with local conditions.

Our waters north of 60 include the areas covered under the Arctic Water Pollution Prevention Act which makes the management of bilge water, and organic waste, a significant concern. The RCN is a leader in protecting our environment during operations and the Victoria-class always makes this a priority. While environmental regulations impose endurance limits during peacetime, they are not insurmountable. Future submarines will need to have advanced treatment systems and larger holding tanks. The requirements to deal with environmental concerns will likely dictate a requirement for larger hulls.

The sheer size of the Canadian Arctic is the final factor I want to highlight and that concerned me

during my time in Command. The Nanisivik Naval Facility is roughly the same distance from Halifax as is Portsmouth UK. The challenge for Pacific deployments is even greater. Nanisivik is further from Esquimalt than Esquimalt itself is from Tokyo. This illustrates how vessels operating in the North are often on their own and need the endurance, stores, and materiel condition to operate without access to support. It also goes without saying that communication issues remain a serious challenge as SATCOM is severely degraded the closer to the poles that one gets, and that HF is constrained by transmitter output power.

Despite these challenges, operating in the North is a natural mission for an SSK and Canadian submarines can and do make those patrols (especially near chokepoints). This is precisely the type of employment that conventional submarines excel at – contributing to the Recognized Maritime Picture by conducting Joint Intelligence, Surveillance, and Reconnaissance patrols along with anti-submarine warfare searches. The large bow sonar array of the VCS, processed by the AN/BQQ-10 sonar system, is a phenomenal long-range sonar. When coupled with a very capable suite of sensors including a Ranging Sonar, towed array, optical periscopes, and Electronic Warfare system, the information is fused into a useable intelligence product by our outstanding submarine crews using the CMS 876 Command Management System and the Electronic Chart Display & Information System.

Going under the ice, other than for relatively short distances, is out of the realm of the possible because conventional submarines lack the unlimited power to create their own breathable atmosphere along with powering ship systems and propulsion. They also lack the sheer size to comfortably break through the ice in cases of emergency or operational necessity however this does not necessarily exclude the RCN from under ice operations. An autonomous underwater vehicle (AUV) doesn't require life support systems nor the ability to break through ice so these systems can provide an under-ice capability. Launched from ships and submarines, they are a growing capability for navies around the world. Indeed, the RCN is leveraging them for Mine Warfare and other tasks. Using them aboard the replacement

for the Victoria-class would allow them to be covertly launched much closer to areas of interest, thereby eliminating the requirement for a long in-bound transit and thus extending the range of submarines. At this moment the underwater launch and recovery technology is not close enough to Technology Readiness Level 9 (aka ready for operations) to be considered for the Victoria-class, but that may change as research and development work progresses. AUVs will unquestionably have a place in the future of naval warfare.

Why CPSP now?

The CAF currently operates four Victoria-class submarines which will undergo incremental modernization in the mid-2020s, thereby ensuring their continued effectiveness to the mid-2030s. This modernization is necessary to ensure the Victoria-class' relevance against contemporary threats until they are replaced. To enable timely decision-making at some future point regarding a replacement class of submarines and to avoid of a gap in submarine capability, the department formally established the CPSP in January 2021. It is important to note that the establishment of CPSP represents standard and routine Naval Force Development work. Establishing a project to replace the Victoria-class in due course does not commit the government to any specific course of action, but instead offers it the time to make an informed decision when required. Yet, this project does not have the luxury of time and is thus intensely focussed on getting through the necessary project governance steps as rapidly as possible.

The procurement timeline from project establishment to contract award is highly specific to each project but allied history has shown that a procurement of a new submarine class will take a minimum of 15 years from project establishment to first delivery depending on the adopted procurement strategy. There are noticeable differences in the timelines based on the procurement strategy. On average, foreign experiences have shown that importing a fully constructed new-build submarine has a timeline of approximately seven years, domestically building an in-service foreign-designed submarine takes 12 years, and domestic building a

new design 13 years. Noting that the Victoria-class will begin paying off (decommissioning) in the mid-2030s, with the final hull planned to be paid-off in 2040, it was necessary to start replacement planning last year. Synchronizing the replacement project with the Victoria-class Class Plan will ensure that as submarines are paying off, they will sequentially provide their crews for training and trials prior to delivery of new platforms.

Significant analysis will be required to determine the design, fleet size, and build strategy. Operating in Canada's three oceans accentuates three important factors to any future acquisition:

Fleet Size - The complexity of the maintenance and intensity of training necessary to achieve high readiness and the constraint of operating from two coasts increases the number of platforms required. The CPSP team is no doubt conducting studies to determine what size of a future submarine fleet would be required to support anticipated missions (both domestic and expeditionary), with an anticipated operational tempo, and cognizant of required maintenance cycles. As we touch on maintenance, it is important to highlight here that submarines are among the world's most complex machines, that operate in an unforgiving environment. This necessitates a rigorous material certification process to assure the safety of the crew and the submarine. This material certification is achieved through a time-based maintenance cycle which forms an essential element of the operational cycle of any class of submarine. What this means is that the size of any fleet must be sufficient to support the range of missions that the government of Canada might require, and to be sustainable for potentially prolonged periods (with sufficient units in reserve to rotate in and out for rest and replenishment as necessary). The size of the fleet must also be sufficient to enable units to undergo periods of deep maintenance following operational periods, to ensure that they remain safe and effective.

Endurance - Given the scale of distances mentioned earlier, a submarine designed to operate in the Canadian Arctic will require significant range and

endurance. These factors have a significant impact on the size of the vessel. For example, transiting from Esquimalt or Halifax to conduct a 14-day patrol of the Northwest Passage would require an endurance of more than 40 days. Operating in a sensitive ecological area such as north of 60 degrees likely means the submarine will need large holding tanks for oily bilge in order to comply with the discharge requirements of MARPOL.

Under Ice Capability - Larger AIP submarines are better suited to operating under the ice near the MIZ. Current AIP systems allow for 14-20 days of continuous dived operations at four to six knots which provide an operational endurance of approximately 2,000nm. This could potentially enable 800-900 nm patrol range under the ice with 30% fuel reserves. Greater storage capacity for the liquid oxygen (LOX) or hydrogen and advances in battery technology may generate better endurance. In addition to range and endurance the submarine's ability to surface through ice needs to be considered. Greater reserve buoyancy allows the submarine to surface through thicker ice. Having read a lot of open-source information, a 4,000-ton submarine would have sufficient reserve buoyancy to surface through approximately two metres of ice. Obviously, this would need further study.

Conclusion

Change is a fact of life. Technology and the changing nature of conflict itself have fundamentally altered the landscape on which we operate. Our sensors and weapons give us a reach that our predecessors could only dream about. We have a great deal of information but still need to determine what is relevant and what is not. We must be able to create effect in environments not traditionally impacted by naval forces. Technology plays a part in the process of maintaining dominance; however, leadership and professionalism in our teams will be the winning factor. I've recently heard it said that teams that dive together, thrive together so I thank you for your interest and investment in this important forum.

RAdm Robinson has spent thirty years in the navy, much of it focussed on submarine warfare, fleet operations, and continental defence. He has also been fortunate to have served three tours in Naval Force Development. He believes that the name Canadian Patrol Submarine Project is inspired and rolls easily off the tongue.

The Under-Ice Environment as a Strategic Space

Adam Lajeunesse, PhD & Tim Choi

In recent years the Arctic has re-emerged as a region of great power competition. While the remilitarization of the Russian Arctic has long been a matter of concern in the West, Russia's February 2022 invasion of Ukraine has injected a new urgency into these considerations. NATO's threat assessments have clearly changed and, over the past three months, the Canadian and American governments have renewed their attention to continental security and our shared maritime border with Russia. Apart from this clear Russian threat, the Arctic has also seen growing non-state interest, and non-Arctic state interest – particularly from China. Taken as a whole, the Arctic security environment is changing, and new capabilities and new cooperative frameworks will be required to meet those evolving threats. For Canada, a submarine capability will be part of that equation.

While much of the Russian naval threat to NATO remains centred on the European High North, Russian submarines have steadily increased their operations in the Arctic Ocean adjacent Canada's northern coast. Terrence J. O'Shaughnessy (former Commander NORAD) and Peter M. Fesler (NORAD's Deputy Director of Operations) issued a clear warning in a 2020 paper, highlighting the fact that Russian "submarines now frequently conduct mission rehearsals for strikes on the United States and Canada."¹ The Arctic, a region that was formerly a moat, has become a "means of approach."² As the government of Canada reconsiders its continental defence plans this summer, the maritime component of NORAD, and the defence of the Arctic will certainly play a central role. As has been the case since the early Cold War, that maritime environment will be dominated by submarines.

The Canadian and American militaries have been here before. In the mid-1980s the Arctic Ocean emerged as a region of particular concern for the US Navy. The Soviet Union's development of the long-range SS-NX-24 cruise missile seemed to give

their submarines the option of launching a stealthy first strike against North American targets from within Canadian Arctic waters. From the 1970s onwards, there was also evidence that the Soviet Navy was beginning to use the Arctic as a regular transit route, allowing nuclear attack submarines (SSN) and ballistic missile submarines (SSBN) to bypass the heavily monitored and defended Greenland-Iceland-UK (GIUK) gap en route to patrol stations in the Atlantic.³ As part of its response to these capabilities, American naval strategy underwent a significant and aggressive shift north. Articulated for the first time in 1984 by Admiral James D. Watkins, the "Maritime Strategy" was a broad concept for the global conduct of war with a focus on defeating Soviet submarines in circumpolar waters.⁴

While the Russian submarine force has shrunk considerably since the 1980s, its strategic interest in the Arctic remains the same. Today, Russia is again deploying new cruise missiles (such as the KH-101/102) with ranges of up to 5,500 km, enabling them to strike critical infrastructure across North America from firing positions in the Arctic.⁵ Carrying these weapons are new or refurbished Russian nuclear attack submarines (SSNs), which continue to be built and upgraded despite that country's failing economy and rapidly depleting (or seized) foreign currency reserves. At the same time, Russia continues to employ sea ice as cover for its SSBNs close to its shores. These are likely to be protected by SSN escorts, which would necessarily have to operate throughout the entirety of the Arctic ice cap. Thus, even though Russia would not need to send its SSBNs close to the Canadian side of the Arctic, its screening SSNs would need to do so in order to interdict potential American or British SSNs approaching from the North American side of the Arctic.

That strategic picture may also become more complicated than it was during the Cold War as

China's growing interest in the region represents a potential long-term peril. A non-Arctic state with newfound polar aspirations, China has been investing heavily in its naval power projection. Whether its Arctic interests, which center on resource development, science, and shipping, lead to militarization remains to be seen. In the short-term, the motivation for China's first Arctic submarine voyage may well be the same as America's in 1958. It was at that point, in the face of the Soviets' success with Sputnik, that USS *Nautilus* was sent across the pole as a demonstration of American technological prowess.⁶ A polar voyage would send a powerful political message, dramatically demonstrating to the world (and the domestic audience) that China is a first-rate technological power capable of the most ambitious and difficult global deployments. This would fall into the PLAN's pattern of growing overseas operations and the publicising of those deployments as symbols of state power. While a Chinese presence remains speculative, it is a serious enough consideration to warrant mention in the US

Navy's new Arctic strategy: "Blue Arctic."⁷

Historically, the field of Arctic maritime defence has been dominated by the United States Navy (USN), given that it was the US that deployed the nuclear attack submarines needed to operate under the polar ice. Canada was largely absent since its diesel-electric Oberon- and Victoria-class boats lacked the extended range and genuine under-ice capability provide by nuclear power. Twice before, this limitation led Canada to seriously consider acquiring SSNs – once in the early 1960s and again in the late 1980s. On both occasions the technical difficulties and costs of building or acquiring these vessels led to the cancellation of the programs.⁸ The current acquisition program is unlikely to retread these same grounds. As the RCN looks to move the Canadian Surface Combatant program forward, the risk and costs involved in nuclear submarines will be prohibitive. As a useful comparison, the recent Australian decision to procure SSNs in partnership with the US and the UK, has been costed at roughly



The advertisement features a large image of a Canadian Surface Combatant ship. On the upper left, the Rolls-Royce logo is displayed above a Canadian flag. The central image shows a robotic crane system (the Mission Bay Handling System) operating on the ship's deck, lifting a small inflatable boat. The background is a dark blue gradient.

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Contract awarded for Royal Navy's Type 26 Global Combat Ship's Mission Bay Handling System

\$70 billion UD (at a minimum).⁹ Canada is unlikely to take on this risk and is rightly focused on a diesel-electric option.

Given its conventional focus, Canada must address the growing strategic threat from the Arctic by accepting that fundamental limitation and reengaging with the USN to rebuild its Cold War Arctic cooperation. While this partnership with the US has often been considered a limitation, or even an affront to Canadian sovereignty itself, the reality is that it has worked well for nearly seventy years and can continue to yield positive results.¹⁰ Yet, cooperation with the US should not mean dependency and Canada must still be able to meaningfully contribute.

Contributing to the defence of the Arctic requires a modern submarine capability. While Canada is highly unlikely to acquire the nuclear-powered vessels that will enable a true under-ice presence, conventional submarines offer essential capabilities along the ice-edge. While year-round access to the Arctic Archipelago is beyond the reach of a diesel-electric boat, the effects of climate change are opening much of the region for longer stretches of the year. While that opening is unpredictable and subject to wild fluctuations in sea-ice coverage, the general trend is clearly an Arctic area that is increasingly accessible to non-nuclear submarines for longer stretches of the years.¹¹

At the same time, that reduction in sea ice extent reduces the under-ice area in which SSNs and SSBNs can hide, making it potentially easier for SSKs to monitor under-ice access. As mentioned above, Russia maintains the practice of stationing its SSBNs under ice. With Arctic sea ice retreating most rapidly on the Russian side of the Arctic Ocean Russian SSBNs and their escorting SSNs will move ever closer to the North American side of the Arctic. While a Canadian SSK may not have the endurance margins to safely transit the ice-covered Canadian archipelagic waterways, it may be able to monitor

such Russian assets from the more open waters on the east side of Greenland. Additionally, developments in autonomous Extra Large Uncrewed Underwater Vehicles (XLUUVs) may provide a safer and more realistic solution to monitoring the Arctic underwater domain from the Canadian side. While UUVs to date have focused on only collecting information and monitoring potential targets, some defence companies have been developing miniaturized torpedoes that can be potentially fitted onto large UUVs that provide them with a prosecution capability.¹²



USS Hartford on ICEX, 2016 (Image: US Navy)

Engine technology has also advanced to the point where Canadian diesel-electric submarines can operate more effectively along the ice-edge. Developments in Air-Independent Propulsion (AIP) technology now provide a submarine with extended submerged range up to several weeks (depending on speed). This is accomplished by virtue of having a second, but still finite, fuel source running through a reaction that does not require fresh air. The most prevalent example by far is the Sterling engine, which uses heat generated by pressurized combustion of liquid oxygen and diesel. This was first adopted for submarine use by Sweden in the late 1980s, and the technology has since been installed on all of their submarines, as well as in most of Japan's Soryu-class boats.¹³ More recently, fuel cell technologies are

providing an alternative to the Sterling engine, with benefits including greater acoustic quieting and less maintenance at the cost of greater complexity. Regardless of the exact method by which AIP is achieved, its growing prevalence in non-nuclear submarines (SSKs) makes them increasingly suitable



USN submarine voyages (1958-1982) (Image: US Navy History and Heritage Command)

for long endurance underwater missions. The possibility of adapting AIP to Arctic use has been debated for decades but is becoming more pronounced as the technologies mature. In 2017, a Canadian Senate Committee even recommended serious consideration of AIP-equipped attack submarines for Arctic operations.¹⁴ These engines provide a partial solution to Arctic operations, allowing submarines to operate comfortably at the ice-edge while venturing into the icepack for a limited time.

While conventional submarines now have greater access to the Arctic in summer, submarines can still deny or monitor access outside of the open seasons by securing choke points. On the West Coast, access to the Arctic Ocean is through the narrow Bering Strait, in the East it is through Davis Strait. Submarines looking to transit the Canadian Arctic must travel through these narrow choke points and that

requirement means surveillance of Canadian waters can be undertaken by watching the gateways – in partnership with the USN and other allied navies. While only a partial solution at the operational level, this capability would provide strategic effect. Even seasonal access to the area, and regular operations around the ice-edge, would enable Canada to deny its enemies the use of the archipelago as a transit route while providing reliable surveillance of who was entering the region. As Phil Webster wrote in the *Canadian Naval Review*, “the mere presence of a Canadian submarine operating in ... the chokepoints in the Northwest Passage, can have a significant impact in assessing underwater activity and the operations of non-Canadian submarines transiting or operating in these areas.”¹⁵

The third point of access to the Canadian Arctic is more open – across the Arctic Ocean from Eurasia. While Chinese access would realistically be limited to the Bering Strait, the Russian Navy is able to deploy freely into the Arctic Ocean from its Northern Fleet bases. Surveillance and defence of the Arctic Ocean and the Canadian High Arctic from this vector would be outside the capabilities of a diesel electric fleet. It would be a mistake however to view operations in the choke points (where Canada can contribute) and operations in the Polar Basin (where it could not) in separate silos. The defence of the continent is an increasingly integrated product of all domain-awareness. This comprehensive picture integrates radars, civilian systems, and maritime detection into a system of systems to ensure detection, tracking, target discrimination, the cueing of interception capabilities.¹⁶ While NORAD is responsible for maritime warning only, Andrea Charron and James Fergusson make the persuasive case that it is only logical that the integration which exists at the aerospace level should be pursued in all other domains – including the maritime – to create a single North American defence command.¹⁷

The integration of Canadian Arctic capabilities into a broader Arctic defence partnership has a long history. During the Cold War, Canadian defence agencies worked with their American counterparts to develop, deploy, and maintain a series of under-ice detection systems across the Arctic Archipelago.¹⁸ By

the late 1980s, Canadian-American teams were testing listening systems north of Ellesmere Island, which would monitor Soviet activity deep into the Arctic Ocean.¹⁹ American submarine operations into the Arctic Archipelago were normally undertaken as joint missions, with Canadian participation in one shape or another.²⁰ In a revitalized renewal of this partnership, Canadian submarines monitoring the gateways to the Arctic Archipelago and along the ice-edge would be invaluable additions to NORAD's operating picture for the Arctic as a whole. In conjunction with a renewal of the Defence Research Board's under-ice detection work,²¹ this contribution would ensure that the defence of the region was a joint responsibility rather than a purely American task.

Beyond greater integration into maritime continental defence, operating submarines provides Canada with a clearer picture of allied operations in the Arctic through participation in NATO's Water Space Management regime. Water space management is best described by Phil Webster as somewhat analogous to a limited air traffic control system that monitors and 'de-conflicts' the movements of allied submarines throughout the world. Through this system, submarines are routed to their operating areas using a SUBNOTE, which provides a "moving haven" – essentially a box in which the submarine operates.²² By operating submarines in the Atlantic or Pacific along the ice-edge – or in the Arctic during the open seasons – Canada gains access to this system, securing access to information about which allied submarines are moving into and out of the Arctic – at least through the commonly used routes.

Understanding what is happening in the Arctic (and under the ice) is vital to Canada. From a political perspective, knowledge and participation safeguards Canadian sovereignty over the waters, the status of which remains contested.²³ Canada's active participation in Arctic maritime defence ensures that American activity in the region takes place within the overall framework of a joint defence effort. Within that framework, agreements dating back to 1952²⁴ ensure that US operations in Canadian internal waters can be authorized through service-to-service channels, removing the kinds potential legal and political thorns that led to sovereignty crises in 1969 and 1985.²⁵ Possessing the ability to interdict hostile actors in the Arctic is also an essential element in national defence. NDP defence critic Derek Blackburn put it well in 1987 when he said that surveillance without response is akin to buying an alarm system but not hiring a policeman.²⁶ As great-power competition increases and activity in the Arctic expands, Canada will need not only that improved surveillance but also the ability to respond to threats within its waters.

The Arctic will be an important consideration when developing Canada's new submarine fleet. While the country will likely not seek to develop the full under-ice capabilities offered by nuclear propulsion, conventional submarines will still provide Canada with the ability to meaningfully contribute to the maritime element of northern continental defence, while offering the government vital insights into what is transpiring above and below the waves in Canada's third Ocean.

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Tim Choi is completing his PhD at the University of Calgary's Centre for Military, Security and Strategic Studies. Tim is a fellow with the Canadian Global Affairs Institute and a former Smith Richardson Predoctoral Fellow at Yale University's International Security Studies, where he worked with Professor Paul Kennedy.

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HMCS Windsor and HMCS Montreal (Image: Sgt Roxanne Clowe, CAF Photo)

Submarine Procurement

Widening the Aperture of Options

Vice Admiral [Ret'd] Robert Davidson CMM, MSC, CD

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The RCN recently announced the start of work to explore options to replace the Victoria-class submarines. Any future submarine procurement must deliver optimum military capability while remaining politically and economically affordable. This can only be achieved if we widen the aperture of options.

Canada needs submarines. Every credible navy in the world today has them – the tactical and strategic arguments in favour of submarines are irrefutable. Submarines bring capability, *gravitas*, knowledge, and experience that are essential elements of a multidimensional modern navy.¹ Any navy aspiring to leadership in the global maritime commons has, and will continue to employ, this essential element of naval combat and surveillance capability. No other platform can deliver the stealth and strategic surprise of a submarine. Those few maritime countries that don't have submarines have made difficult political and economic choices that do not diminish a submarine's inherent value and operational utility. Simply put, as a G7 nation that is highly reliant on maritime trade and with the world's longest coastline, Canada needs submarines.

The Department of National Defence (DND) will need to convince Cabinet that this capability is worth the political and economic capital. A funding envelope and spending authority will be essential and an early Memorandum to Cabinet (MC) is, therefore, a logical first step. Such an MC will need to address:

- Arctic and under-ice requirements.

- Surveillance on three coasts, including the number of hulls needed.
- An ability to operate overseas with our allies.²
- Range, endurance, combat and surveillance capability.
- Industrial offsets (that translate into jobs).
- Regional benefits (that translate into votes).
- The National Shipbuilding Strategy (existing policy framework).

High quality steel for submarines is expensive and working with it requires a unique skill-set. Canadian industry currently lacks the expertise and facilities for submarine construction, and establishing that capability would inflate the cost. Ideally, Canadian industry will focus on component construction and systems integration.

Considerable risk lies in any view that only unique design work will meet Canada's requirements. Such work has consistently resulted in escalating costs, largely arising from delays, unique made-in-Canada solutions, changing scope, and inflation. Escalating costs lead to a loss of faith and trust in DND's ability to forecast and deliver major projects.

The recent Australia/UK/USA (AUKUS) strategic agreement may have changed the environment. It may open the potential for a nuclear propulsion option without necessarily creating a nuclear supply chain in Canada, the cost of which doomed our last exploration of this option in the late 1980s. While nuclear propulsion has clear

advantages, it is a stretch to believe that any Canadian government will find nuclear propulsion politically saleable in the current environment, particularly for Arctic applications. Still, the government should make this call and so it should not be excluded from consideration.

Nevertheless, we should focus efforts on a conventional submarine option with Air Independent Propulsion (AIP).³ AIP is essential for safe and effective operations in areas near ice and brings enormous tactical advantage in stealth. Most existing designs allow for roughly three weeks of independence from the surface, depending on speed and the nature of operations. Some level of ice reinforcement of the fin area would also be needed to penetrate Arctic ice in an emergency or for communications.

We must consider the Arctic of 2050 and beyond. A full climate forecast is essential in advance of any decision. Canada's submarines must be able to operate where and when we can reasonably expect to see a threat to our sovereignty. Ice thickness and extent will change with global warming. Could the ability to surface through up to one meter of sea ice be sufficient for future requirements? Can we expect that there will be more polynyas and open water areas?⁴ Could three weeks of AIP be sufficient? Options should be backed by sound research and forecasting.

The hydrographic work to improve Arctic charts also needs increased efforts now as part of Canada's sovereign responsibilities and to improve navigation safety for all shipping in the Arctic, including submarines.

Bigger hulls use more steel and are therefore more expensive; this could limit the number of hulls that can be afforded. Bigger submarines also have limited shallow water access, except when equipped with underwater remote vehicles. Submarine vulnerability and detectability increase with size. Conventional submarines, even with modern batteries and AIP systems, are limited in their speed and endurance – compared to their nuclear cousins. Quite simply, without nuclear propulsion, the

power-to-weight ratio favours smaller submarines. Bigger may mean more range but it may not produce a dramatic increase in AIP endurance over some of the smaller submarines already in service. Fixing the size requirement at 3,500 tons or more, as recommended by some analysts, starts us down a limiting and costly path. Smaller submarines should be included in the analysis and options. A smaller hull size opens the door for more submarine yards and builders to compete while smaller less costly hulls may mean more submarines are affordable.

When it comes to the actual operation of submarines and ships, the Navy calculates cost and effort in terms of sea days. Incremental costs for crew, including fatigue, and maintenance are driven by days at sea. For a submarine, this is further compounded by days submerged affecting hull fatigue. Sea days are made up of:

- Trials and Equipment testing
- Transit time
- Time on patrol for operations
- Training time for the submarine crew
- Training time for other platforms (ships and aircraft) that must also practice hunting for submarines.

Given the slow transit speeds for conventional propulsion, many sea days are expended in transit. Each transit day reduces the available days on patrol or in the assigned operating area. Long distances in transit to overseas and Arctic deployments result in fewer patrol or surveillance days. This has been a perennial problem with Canada's submarines and has been a key factor in limiting the frequency of overseas deployments of the Victoria-class. Options to reduce transit days should be explored.

Remotely operated vehicles (ROV) are a useful addition to submarines but not a substitute. If we intend to keep a human in the decision loop with sufficient combat capability, then ROVs alone will not do the job. Underwater gapped communications lack the data rate or fidelity needed for such complex operations and tethered applications are range limited and not environmentally friendly. Artificial intelligence may open new options, but we

are not ready to let machines do autonomous submarine combat operations.

A smaller submarine (2,000-2,500 tons), combined with a Heavy Lift Ship (HLS), offers many potential advantages and should be considered:

- The HLS transports the submarine to the operations area eliminating the transit/range problem that favours a larger submarine
- The HLS can be built in Canada, creating a valuable industrial offset.
- With no submarine sea days lost in transit, more operational days are available in any deployment.
- The HLS can provide repair facilities, docking, refuelling (including AIP), re-arming or weapon change-outs, re-storing, and submarine crew accommodations closer to the operating area.
- Crews can be flown to join the deployed submarine/HLS.
- Some repairs that previously forced an early

return transit to home port can be addressed locally.

- Special Operations capabilities and personnel can be housed in the HLS
- The HLS has utility for humanitarian lift to northern communities and areas affected by natural disasters.
- An HLS could be operated by industry.

Any study of options to replace the Victoria-class needs a wide aperture. Requirements should be established for 2050 and beyond where changes in technology and the Arctic environment may offer substantially different operating parameters from our current experience. Options to solve the transit and range challenges such as the combination of a heavy lift ship with a small submarine merits consideration. Most importantly, our procurement plan should minimize the procurement duration to reduce cost and risk. Key strategies to achieve this include avoiding unique designs and a built-in-Canada solution.

HMCS Chicoutimi arrives at its home port of Halifax aboard the Norwegian sealift vessel M/V Eide Transporter (Image: Cpl Mike Selig, Combat Camera)



Notes

¹ A modern Navy needs experience across the spectrum of maritime operations to be credible to lead international operations. Submarines also offer access to the club of submarine operating allies within which intelligence and movement information is exchanged. A submarine with a heavy weight torpedo and/or anti-ship missiles is a strategic capability that can deny area access to an adversary.

² While may carry less weight nationally, it will be key for our NATO and other allies

³ AIP is any technology that provides for the generation of power without access to atmospheric oxygen. Batteries, closed cycle and Stirling engines and fuel cells. These systems may require stored hydrogen and/or oxygen or a reformer that can produce hydrogen from another fuel source. AIP enables a submarine to remain submerged for extended periods without accessing the atmosphere to run large diesel engines.

⁴ Canada's Arctic currently contains 23 polynyas or open-water areas surrounded by sea ice. These are created by winds, currents and upwelling warmer water. (Source: Canadian Geographic, Status and trends in Arctic Biodiversity)



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Canada's Submarine Assets

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Canada has operated submarines since the First World War when British Columbia acquired two small boats from an American shipyard to quell local fears of German raiders. In the five decades that followed, the submarine service was small and the Royal Canadian Navy (RCN) commissioned only four boats, two captured German U-boats and two British H-class vessels.

In the years following the Second World War, Canadians maintained the skills necessary to operate submarines primarily with boats loaned to the RCN by Britain. Cold War requirements brought Canada back

into the submarine game and, in 1962, approval was received for the acquisition of the *Oberon*-class attack submarines, which were operated until 2000.

Canada's current submarine fleet comprises four *Victoria*-class diesel-electric attack submarines (SSKs), which replaced the decommissioned *Oberon*-class. Divided between the Atlantic and Pacific fleets, the *Victoria*-class is made up of: HMCS *Victoria* (876); HMCS *Windsor* (877); HMCS *Chicoutimi* (879); and HMCS *Corner Brook* (878).

These vessels are renovated British ships of the *Upholder*-class (Type 2400s). Built by the Royal Navy

in the late 1980s and early 1990s, the vessels were purchased second-hand by Canada in 1998. After significant and, sometimes unexpected, work to integrate them into RCN technology and equipment ('Canadianization'), they were delivered to the RCN between 2002 and 2004. Crewed by approximately 50 officers and sailors and displacing 2,475 tonnes (submerged), the *Victorias* are capable of speeds of up to 20 knots and an impressive range of roughly 8,000 nautical miles (at 8 knots). They are larger than most modern diesel electrics, though only half the size and speed of their larger nuclear counterparts.

The *Victoria*-class has several missions and functions. They were built as anti-submarine warfare (ASW) platforms to locate and destroy Soviet submarines during the Cold War. Because hunting enemy submarines is done primarily by acoustic detection, the ability to listen in silence, while moving in and out of the ocean's different thermal layers to hide and seek, the best platform to destroy an enemy boat has long been one of your own.

Despite considerable difficulty integrating them into the RCN – and the long period of update and initial renovations – they were and remain highly capable assets. Armed with the US-made Mark 48 torpedoes and advanced sensor systems, the *Victorias* have become excellent tools for surveillance, defence and deterrence along Canada's coasts, as well as routine fisheries patrols and support to law enforcement.

These vessels operate on both the East and West Coasts and deploy regularly abroad alone and in partnership with Canada's allies. They are not capable of operating in the Arctic and have made only symbolic journeys north. Because a diesel submarine operates underwater on batteries, those batteries rely on a diesel engine to recharge and that recharging can only take place on the surface, where diesel exhaust can be vented. As such, Canada's submarines have a limited submerged range. While this is suitable for the vessels' tactical employment in combat and surveillance, it makes operations under ice impossibly dangerous, since surfacing in the Arctic often requires waiting for the right conditions.

Sometimes described as a strategic asset, these boats have become a 'special force' component of the Canadian navy due to their ability to control space through their very existence. Because they cannot be easily detected, the presence (or assumed presence) of

an attack submarine serves as a deterrent to potential adversaries, altering that opponent's decision-making across an entire maritime theatre.

In times of conflict, these submarines are Canada's most effective means of countering enemy submarines or surface craft to ensure the safety of Canada's coasts. They are also the best platforms for operating in dangerous environments, where surface combatants would be at risk from air- or ground-based missile attack. Their combat capability is augmented by highly sensitive acoustic, electro-optic and electromagnetic sensors, as well as an advanced bow sonar. As a result, they can monitor large undersea areas for other submarines and detect and track surface vessels at great distances. Compared to the larger nuclear submarines operated by many of Canada's allies, the smaller size of the diesel-electric boats also makes them ideal vessels for operating close to shore – an increasingly prevalent task in modern military operations.

Canada does not have nuclear submarines. Nuclear submarines are a commonly misunderstood weapons platform. Often associated with nuclear missile-carrying ballistic missile submarines (SSBN), a nuclear submarine is actually defined by its use of a nuclear power plant to provide propulsion. Canada considered acquiring nuclear attack submarines (SSN) in the late 1950s/early 1960s and again, far more seriously, in the late 1980s. These vessels were nuclear-powered but not nuclear-armed – meaning that they would use conventional torpedoes and not nuclear missiles. On both of these occasions, the extreme cost of the nuclear plant and the onshore support requirements dissuaded the government from making an acquisition.

Conventional diesel-electric attack submarines, like the *Victoria*-class, have certain advantages over larger nuclear-powered vessels. Their electric propulsion system makes them extraordinarily quiet, providing a decisive advantage in certain scenarios, especially operations in shallow waters and strategic choke points. This stealth and strategic area defence makes them a valuable strategic asset for Canada and a useful training tool for Canada's allies.

Canadian submarines are an important element of Canada's strategic relationship with the United States. Because the US Navy operates no diesel-electric submarines of its own, the *Victoria*-class regularly

trains with American ships to prepare for combined operations against an enemy possessing a similar capability. Canada also participates in a global ‘water space management’ regime, in which allied submarine operators share information about the movement of their submarines in order to prevent a collision. As a member of this exclusive ‘sub club,’ Canada gains privileged access to naval intelligence that would otherwise be beyond its reach.

Canada’s *Victoria*-class submarine fleet has been active at sea since 2003. In that time, these boats have undertaken a diverse set of missions spanning the security and defence spectrum. They have participated in exercises at home and overseas, patrolled Canada’s coastal areas – including the Arctic (although not under the ice) – and worked in partnership with Canada’s allies in international operations such as *Operation Caribe*, a counter-drug operation in the Caribbean, and in 2018, a Canadian submarine visited Japan for the first time in many years.

Following the return of HMCS *Windsor* from a Mediterranean deployment in 2018, Canadian submarine operations experienced a pause in operations and were not active in 2019 and 2020. All four of the submarines spent time in various stages of maintenance or modernization. HMCS *Victoria* returned to sea for trials in September 2020 after time in dry dock on the West Coast where it underwent routine maintenance, repairs and upgrades, including a new sonar and new battery among other things. A new capability was tested in fall 2020 as *Victoria* worked with a helicopter hovering overhead to practice transferring equipment and personnel to the submarine. HMCS *Corner Brook* finished its extended docking work period in June 2021 and after sea trials will return to operational status, and HMCS *Windsor* finished a maintenance period in March 2021 and returned to sea, most recently participating in Exercise Cutlass Fury in September 2021.

Submarines are an important part of what Canada’s naval policy, *Leadmark 2050*, describes as a ‘balanced’ fleet. This means a fleet capable of deploying globally, controlling maritime space, surreptitiously collecting intelligence, and supporting government of Canada objectives across the security and defence spectrum.



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