# CANADIAN NAVAL REVIEW

VOLUME 16, NUMBER 3 (2021)

Winner of the 2020 CNMT Essay Contest

## Canada and the Fourth Battle of the Atlantic

## "We Will Not March at the Back": The Women's Royal Canadian Naval Service

## Chemical Weapons Disposal and the Scuttling of LST 3521 in 1946

## Ice Navigation and Arctic Security

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# CANADIAN NAVAL REVIEW

VOLUME 16, NO. 3 (2021)

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Today's Policy Questions, Tomorrow's Policy Leaders



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Credit: Corporal David Veldman, Canadian Armed Forces

*HMCS **Glace Bay** sails under the northern lights in Arctic waters between Canada and Greenland during **Operation Nanook-Tuugaalik** on 18 August 2020.*

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*Editorial*

# Democratic Naval Powers Should Not Look Away

Well before the onset of the COVID-19 pandemic, geopolitical transitions had begun to reshape the nature of national defence challenges faced by Canada and its allies. The transitions began in the months after the fall of the Berlin Wall decades ago. The traditional authoritarian global competitors of the West like China, Russia, Iran, North Korea, and some of their proxies, studied the lessons of the two Gulf Wars and the projection of US naval power in the Straits of Taiwan, and recalibrated their competitive kinetic, cyber and technology tactics in various ways.

The Chinese built expanded naval, air and missile capacity, and the Iranians invested heavily in armed proxy groups like Hamas and Hezbollah that have acted as destabilizers in their region. The Russians developed cyber and disinformation tactics to weaken and intimidate Estonia, Latvia and Lithuania, former Soviet states in the Baltics and now members of NATO, and in some cases invaded bordering states like Ukraine and Georgia. Russia has also intervened in support of the Bashar al Assad regime in Syria and in the process is testing new armaments and air-to-ground combat techniques and murdering thousands of innocent civilians. This has contributed to a broad refugee crisis affecting Europe.

As we come to terms with these post-Cold War geostrategic changes reshaping the capacities and technologies defining the new threat spectrum, what might this all mean for allied naval forces and for the Royal Canadian Navy (RCN) in particular?

The emergence of a more adventurous Russia, posing a genuine kinetic and cyber threat to Canada's Eastern European, Baltic and Scandinavian allies, now combines with the more aggressive approach of China as a more assertive, intolerant and expeditionary regional hegemon. This authoritarian partnership means that allied navies – including formal NATO members and Asian allies and partners – need enhanced deployability, more joint planning, improved naval intelligence and, frankly, the capacity to deploy simultaneously in both Pacific and Atlantic theatres. The strategic capacity of free world navies to deploy in combat and tactical support of air, land and Special Forces is joined with the need to restrain and contain potential aggression by being broadly present, on an ongoing basis, in key potential hostile ocean theatres. That means Atlantic NATO powers deploying collaboratively with Australian, Japanese, Indian, South Korean, New Zealand and other democratic Asian powers making the unified nature of any response clear to Chinese competitors. These deployments need to benefit from advanced cyber-intelligence and other vital signals and satellite real-time data that provide active support of allied forces on patrol from the Indian Ocean to the South China Sea and the Straits of Taiwan. It is vital that China and Russia have no reason to doubt our capacity or our will to engage in response to any aggression. Recent NATO naval exercises in Russia's Arctic seas, as well as joint exercises in our own Arctic region, are reflective of this vital strategic requirement.


*Credit: Sailor 1st Class Valerie LeClair, MARPAC Imaging Services*

*HMCS **Winnipeg** sails alongside the Japan Maritime Self-Defence Force destroyer JS **Shimakaze** in the western Pacific on 17 November 2020 during **Operation Neon**.*


*The Swedish submarine HSwMS **Gotland** is seen here after its mid-life refit in May 2020. In response to Russian actions, the December 2020 Total Defence Bill will increase Sweden's defence budget by 40% between now and 2025, which includes expanding its submarine fleet from four to five submarines in total.*

This will mean higher costs and increased expenditures for allied free world navies in support of more deployments, more platforms and naval task forces at sea on a prophylactic war footing. And in response to those governments, including Canada's, which may balk at these increased costs, the reply by parliamentarians and citizens should be clear.

In the same way that there is an International Monetary Fund and World Bank consensus, supported by central bank governors, to set aside austerity or short-term debt concerns in favour of the need to spend in support of economic survival in face of the Coronavirus threat, so too must the enhanced strategic threat from Russia and China, heightened during the COVID period, be met with whatever expenditures are required. Wish lists for new technology and cyber systems capable of active measures against deployed enemy capacity need to be dusted off and pursued with intensity in support of the RCN and allied navies.

In October 2020, an article in *The Economist* reported that the usually neutral Swedish Parliament was presented with a budgetary proposal by the government to increase defence expenditures by 40%, broadening the armed forces' complement and expanding air and naval capacity, in the face of numerous Russian incursions in Swedish air space and territorial waters. Complacency in the face of a sharp-edged authoritarian naval capacity in the Atlantic, Pacific or Arctic is no virtue in our present intense and expanded threat context. The cost of restraining and deterring aggression is much less than the cost of responding to aggression and conflict after the fact.

Negotiated resolution of international tensions is always preferable to the perils of combat. However, authoritarian regimes which face no internal accountability from either domestic opposition or a free media, seek no negotiations as they expand their territorial or aggressive reach, seeking to intimidate and destabilize. The Chinese have flouted international law. The Russians have invaded other countries, and this has all happened since the end of the Cold War. Both countries seem caught in a narcissistic loop with either past Soviet Union sway or, in China's case, a mix of perceived decades of humiliation and contrived misrepresentation of the UN police action against Chinese invaders in Korea decades ago. Both countries exhibit a classic authoritarian fixation with glorified overstatement or mis-statement of history. The present and future naval forces of freedom must be both firm and credible in their will to constrain, deter and defend. Freedom of navigation and open sea routes for trade and passage worldwide are not 'wouldn't it be nice' goals. They are essential to trade, security and global cooperation. Whether it is Russian submarines, Chinese aircraft carriers or violations of territory on the land, sea or air by authoritarian military powers, the navies that defend freedom, backed up with assets on, above and beneath the sea, need to ensure a preventative and ongoing presence that sends a clear message of no impunity for any kind of aggression.

As to how these preventative deployments are shaped and engaged, what forces are used and what assets deployed where and when, these are appropriately the decisions to be made by uniformed High Command and Flag Officers of NATO and allied navies in concert with the leadership of their armed forces and their defence ministries. These plans will require a mix of urgency and high security. Not making plans for this kind of enhanced and unified free world deployment would be an abdication of the most serious nature.

The Royal Canadian Navy, for its size, is a well-trained and professional force for good worldwide. Whether off the shores of the Korean peninsula, in the South China Sea, in the Mediterranean, in Canada's own Arctic or on anti-submarine patrols, the RCN's capacity has never mattered more.

NATO prevented war for over half a century by being ready, in large numbers and kit, to deploy rapidly, making the costs of Soviet adventurism clear. The RCN was an important part of that success. The new threat spectrum embraces both Pacific and Atlantic naval theatres without diminishing Canada's hemispheric obligations for the Caribbean and NORAD sea patrol. While the challenges of the pandemic take priority over other domestic issues, allowing a further re-ordering of the global balance of power driven by authoritarian actors and proxies would be a serious abdication of duty by the forces of the democratic world.

Governments and Parliaments around the free world should not look away. CNR

Hugh Segal

*Winner of the 2020 CNMT Essay Competition*

# Canada and the Fourth Battle of the Atlantic

**Commander Peter Sproule**

*Credit: Norwegian Defence Forces*

*The Russian aircraft carrier **Admiral Kuznetsov** (left), nuclear-powered cruiser **Pyotr Velikiy** and the destroyer **Vice-Admiral Kulakov** sail along the Norwegian coast in October 2016.*

In late June 2020 NATO's Joint Force Command Norfolk (JFC-NF) and the US Navy 2nd Fleet hosted the Fourth Battle of the Atlantic Tabletop Exercise, bringing together NATO naval leaders to prepare for future security threats in the North Atlantic.[1] This conference was the first, not the fourth, of its kind – the title referred instead to the premise, put forward by a previous Commander of the US Navy's 6th Fleet, that NATO was now engaged in a fourth Battle of the Atlantic.[2] The first two Battles of the Atlantic were fought against the Germans during the World Wars, and the third was waged to contain the threat posed by the Soviet Union to NATO's sea lines of communication. This latest Battle of the Atlantic has arisen in response to the return of confrontation between NATO and a belligerent Russia.

Much of the concern about Russia's return to the world stage has focused on the invasion of Crimea and support to separatists in Ukraine, or the large-scale military exercises near the borders with the Baltic states Lithuania, Estonia and Latvia (which are all NATO members). However, it is Russia's naval resurgence, and specifically its submarine activity, that poses one of the greatest threats to NATO. Russian submarine activity has increased dramatically in the past decade, following the low point of Russian naval readiness in the 1990s and early 2000s, capped by the sinking of *Kursk* in 2000. From the eastern Mediterranean where new submarines have been launching missiles into Syria, to the North Atlantic where the Russians have been announcing their presence with large-scale submarine exercises, Russia has become increasingly assertive towards NATO, testing the alliance's ability to detect and deter a modern and capable submarine force.

Russia's submarine activity has caught the alliance flat-footed. After years of NATO being focused on peacemaking in the former Yugoslavia and then counter-insurgency and asymmetric warfare in Afghanistan, defence spending and training resources had shifted away from high-end, naval warfighting. Many countries had let their anti-submarine warfare (ASW) capabilities atrophy.

In spite of the challenge to NATO, Russia's re-emergence offers an opportunity for Canada to regain a leading role in alliance ASW. By virtue of its geography, investment and willpower, Canada played a key role in fighting two of the previous Battles of the Atlantic, which provided the country with the knowledge, equipment and experience needed to compete in this field today. Canada was only a marginal participant in the First Battle of the Atlantic in the last half of the First World War. However, during the Second World War after a rough start, the Royal Canadian Navy (RCN) and Royal Canadian Air Force (RCAF) played a vital role in defeating the Nazi submarine threat. By the end of the war the Canadian Northwest Atlantic Command was one of three zones of operation in the Second Battle of the Atlantic and the only major theatre in the war commanded by a Canadian.


Credit: Mass Communication Specialist 1st Class Jason Pastrick

*Admiral Christopher Grady, Commander of US Atlantic Fleet (formerly Fleet Forces Command), speaks with Vice-Admiral Andrew Lewis, Commander of Second Fleet and Joint Forces Command Norfolk, during the Fourth Battle of the Atlantic tabletop exercise in June 2020.*

Having ended the Second World War with a large navy and hard-earned experience in ASW, the RCN was well prepared for the Cold War threat posed by the Soviet Union in the Third Battle of the Atlantic. Although the dreams of RCN planners for a large, multi-ocean fleet quickly evaporated after 1945, the establishment of the Iron Curtain and the creation of NATO meant that Canada resumed a meaningful role in ASW, protecting the sea lines of communication from North America to Europe. The threat from the Soviet submarine force continued to increase through the Cold War period, and jumped dramatically with the introduction of ballistic-missile submarines into the Soviet fleet in the 1950s. Canada's commitments to NATO spared the RCN's ASW capabilities from the government axe even as budget cuts led to the loss of aircraft carriers and other niche naval specialisations.[3] By the end of the Cold War, Canada's maritime forces consisted of three submarines, 16 ASW-capable frigates and destroyers, embarked RCAF Sea King helicopters, and a fleet of shore-based Aurora aircraft, providing a small but multifaceted force that was well suited to countering sub-surface threats to the NATO alliance.

In addition to its ASW-focussed fleet structure, Canada also belongs to the small club of states involved in the US Navy's secretive Sound Surveillance System (SOSUS), which was established early in the Cold War. This system involves a number of hydrophone arrays fixed around the Atlantic and Pacific Rim, and now also incorporates specially-designed ships towing advanced hydrophone arrays and low-frequency sonar systems. SOSUS was designed to detect Soviet and other submarines by taking advantage of the long-range sound propagation in the oceans. Canada's contribution to SOSUS started at the Canadian Forces Station Shelburne and the USN (and later Canadian) station in Argentia, Newfoundland. As the system was amalgamated to centralised stations, the RCN consolidated its efforts alongside its allies. With the end of the Cold War SOSUS was declassified and rebranded as the Integrated Undersea Surveillance System (IUSS) operating out of two US stations for the Atlantic and Pacific Oceans. Currently, only three states – the United States, United Kingdom and Canada – are directly participating in the IUSS mission.

The end of the Cold War led to a rapid degradation of ASW capabilities across NATO forces as the submarine threat seemingly disappeared and urgent missions in the former Yugoslavia and Afghanistan consumed alliance attention and resources. Across NATO, surface and submarine fleets were reduced or aged into obsolescence, with some countries divesting of certain ASW capabilities entirely. Several NATO members, such as Spain and Germany, are presently building new classes of ships with little to no ASW capability, as the programs were started during a period when there was no significant sub-surface threat. In the early 2000s Denmark's navy divested itself of its aging submarine force without planning for a replacement, and the Netherlands sold off its Maritime Patrol Aircraft (MPA) fleet. The United Kingdom, long a leader within NATO in the anti-submarine field, reduced its surface and sub-surface fleets significantly, and there was a gap almost a decade long in MPA between the retirement of the Nimrod fleet in 2011 and the arrival of the first P-8 aircraft from the United States in 2019.

While NATO's ASW forces have been reduced, the alliance still maintains a robust capability made up of fixed- and rotary-wing aircraft, ships, submarines and fixed arrays. Additionally, the reduced number of operational Russian submarines, both nuclear and conventional, has relatively strengthened this capability since the collapse of the Soviet Union in 1991. However, although Russia no longer has the numbers, the quality of its submarines has improved immensely since the 1990s. Russia is still operating the last and best submarines from the old Soviet fleet, including the nuclear *Oscar II*, *Akula* and *Sierra II* submarines, as well as *Kilo*-class diesel-electric boats. In the last decade the Russian Navy has also brought modern and extremely quiet new boats into service – including *Severodvinsk*, the first of the *Yasen*-class guided-missile submarines (SSGN), and the new *Borey*-class ballistic-missile submarines – to update its at-sea nuclear deterrent. In addition to new submarines, Russia has also equipped its submarine fleet with sub-launched Kalibr missiles, both the anti-ship and land-attack versions, which have greatly increased the fleet's reach and lethality. In 2015 and 2017, *Kilo*-class submarines from the Black Sea Fleet operating in the eastern Mediterranean successfully fired Kalibr missiles at targets in Syria.

The threat posed by these new platforms and weapons is not the same as that faced by the Allies in the First

and Second Battles of the Atlantic, or even that faced by NATO in the Third Battle. The risk that one or two Kalibr-equipped submarines could pose to NATO military and civilian infrastructure is potentially greater than the threat of severing the sea lines of communication between North America and Europe that had always been the previous goal of adversaries. This threat is a new one for NATO as in the past Soviet submarines could only threaten land-based targets through a nuclear attack, with the resulting expected escalation from both sides. When paired with third-party targeting provided by aircraft or even space-based surveillance systems, undetected submarines far from shipping lanes could also threaten naval forces and the Atlantic bridge between North America and Europe.[4]

Submarines are only one aspect of Russia's naval development strategy. It has also launched new surface ships equipped with Kalibr missile systems. Russian shore-based missiles and aircraft are also able to project power across the Baltic and Black Seas. However, these new ships are much easier to track and are both out-numbered and arguably out-classed by new or upgraded NATO ships. As well, out in the open Atlantic Ocean Russian ships lack the same level of support from ashore that NATO can provide. The Russian deployment of the *Kuznetsov* aircraft carrier group to the eastern Mediterranean in 2016 was not only tracked continuously by NATO ships and aircraft, it was also plagued with engineering difficulties and the crash of two of the carrier's planes while trying to land on board the carrier. It is only in the sub-surface theatre that Russia poses a significant threat in the North Atlantic. As Vice-Admiral Andrew L. Lewis, the head of the USN Second Fleet, said in February of 2020,

> The Atlantic is a battlespace that cannot be ignored. Our new reality is that when our sailors toss the lines over and set sail, they can expect to be operating in a contested space once they leave Norfolk. We have seen an ever-increasing number of Russian submarines deployed in the Atlantic, and these submarines are more capable than ever, deploying for longer periods of time, with more lethal weapons systems.[5]

Countering this renewed assertiveness will take a multi-pronged approach by NATO partners. Renewed investment in ASW-capable platforms is important, but procurement fixes take many years to produce results. Even the UK's fast-tracked P-8 Poseidon purchase will have taken almost a decade from announcement to full operational capability in the early 2020s. More must be done with the tools that NATO already has available. Divestment of forward bases by NATO partners needs to be reversed quickly and, indeed, efforts have been made in this regard. Although the United States closed the Keflavik Naval Air Station in Iceland in 2006, in recent years it has again been using the airfield for maritime patrols and is in the process of upgrading hangars to accommodate P-8 Poseidons. In 2009 Norway closed and sold off Olavsvern, its submarine base carved into the side of a fjord in the far North, and for several years the new owners were even


*Credit: Mass Communication Specialist 1st Class Jason Pastrick*

*Participants of the Fourth Battle of the Atlantic tabletop exercise are seen in this image dated 1 July 2020.*

Credit: Danish Defence

*The Russian Oscar II-class submarine **Smolensk** sails through the Danish Straits on 10 July 2019 on its way to Saint Petersburg for the annual Navy Day parade.*

renting the base to Gazprom, the Russian state-owned gas company. Although Norway has not reopened the facility, in 2019 a company that provides logistical support to the Norwegian military purchased a majority stake in the base, preventing further use by the Russians and suggesting the possibility of Norwegian and NATO submarines returning.

NATO has been increasing the size and complexity of its two main ASW exercises, Dynamic Manta and Dynamic Mongoose, to ensure that its sailors and aviators are proficient in the highly perishable skills that go into finding, tracking and attacking submarines. USN Second Fleet, which was stood down in 2011 as a cost-savings measure, was re-established in 2018 with Vice-Admiral Lewis dual-hatted as the head of NATO's new JFC-NF which announced initial operational capability in September 2020. Both these commands were established to reinvigorate the ASW response of the USN and NATO to the renewed Russian threat,[6] and it was to that end that they co-hosted the Fourth Battle of the Atlantic tabletop exercise mentioned earlier.

However, dealing with even individual submarines is not just a tactical but also a theatre-level activity. Multiple ships and aircraft, often from different states, must be coordinated so that units are available to maintain tracking of the submarine for long periods and hand-offs among aircraft, ships and submarines can be coordinated to ensure the target submarine does not escape. The management of theatre-level ASW is just as important a skill as unit-level operator proficiency, but is only infrequently practiced across NATO. This is a challenging area to exercise, as most theatre-ASW activities occur at the fleet Command or national levels through requests of assistance from participating states and the coordination of their actions. These responses are measured in days rather than in the hours that unit-level combined anti-submarine exercises tend to take.

What is Canada's role in all of this? Given its history of involvement in ASW, and more importantly the country's continued engagement in this area of warfare, Canada is well positioned to take a lead role in revitalising NATO's ASW capabilities. By virtue of its geography, the Atlantic bridge will always be of vital concern and, as a result, Canada is one of the few NATO states engaged in all aspects of ASW: patrol aircraft; ASW helicopters, surface ships and submarines; and IUSS fixed arrays. The ongoing introduction of the Cyclone helicopters, along with the modernisation of the Aurora Maritime Patrol Aircraft and the future Type 26 frigates, will ensure that Canada will be able to continue to field modern and effective ASW assets. RCN and RCAF units continue to be active participants in international and NATO ASW exercises in order to maintain a credible level of capability in the field. Given all of this, it is likely that Canada will continue to hold a leading role in ASW within NATO.

Credit: Timothy Choi

*In 2004, Denmark divested itself of its submarine fleet with no replacement. HDMS **Sælen** was one of the last in the fleet and was turned into a museum ship, seen here in Copenhagen on 12 July 2018.*

Credit: Airman Apprentice Amariv Perez, US Navy

*A pair of P-8A Poseidon maritime patrol aircraft sit on the apron at Keflavik Airbase in Iceland on 2 January 2020.*

There is more that Canada can and should do to contribute to NATO's ASW efforts however. I propose that a NATO Centre of Excellence for Anti-Submarine Warfare ought to be established in Halifax, Nova Scotia. While there are NATO Centres of Excellence in numerous areas of warfare, including military medicine, naval mine warfare, and modeling and simulation, no centre exists for ASW. Correcting this oversight is one of the major recommendations that a US think-tank, the Center for Strategic and International Studies, called for in its 2016 report *Undersea Warfare in Northern Europe*, which reviewed the status of NATO's readiness in relation to the re-emergence of a Russian submarine threat.[7] NATO does have the Centre for Maritime Research and Experimentation in La Spezia, Italy, but its focus is on the scientific and technological aspects of tracking sub-surface contacts rather than tactics and theatre-level coordination. An ASW Centre of Excellence would allow NATO partners to develop up-to-date tactics, techniques and procedures, at both unit and theatre levels, to deal with the new reality.

Given the loss of capability that the alliance has experienced in this area of warfare, and given the renewed subsurface threat, the lack of an ASW Centre of Excellence is an obvious deficiency in need of correction. Establishing it in Canada would simultaneously develop an ASW leadership position and strengthen the country's contribution to NATO for relatively little cost. Basing the centre in Halifax would also allow it to take advantage of the proximity to the Canadian Forces Maritime Warfare Centre and the Canadian surface and air ASW communities in Halifax, Shearwater and Greenwood, Nova Scotia – and for these bases to take advantage of enhanced NATO presence and expertise.

Along with establishing the ASW Centre of Excellence, Canada should focus its major East Coast naval exercise, Cutlass Fury, on anti-submarine warfare, including theatre-ASW. While the first iteration of the exercise in 2016 was focused on ASW, with submarines from Canada, the United States, UK and France participating, the second exercise in 2019 only featured one US submarine and was predominantly a surface and anti-air warfare exercise. By ensuring that future Cutlass Fury exercises revolve around ASW, and include theatre-level training events, Canada can help advance NATO's skills in these areas and ensure that high-level ASW exercises are available to participants on both sides of the Atlantic.

Going forward, NATO has to accept that Russia has re-emerged as a great power competitor and will not be going away any time soon. One of the areas where Russia poses the most threat to the alliance is in the undersea domain with its new and formidable submarine fleet. Canada has a long history of being a leader in this area and, with a renewed national commitment to anti-submarine warfare, the country has an opportunity to take a lead within NATO. While the lessons identified at the Fourth Battle of the Atlantic tabletop exercise are still fresh in mind, Canada needs to take station at the fore of the efforts to revitalise the NATO alliance ASW. CNR

**Notes**

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2. James Foggo III and Alarik Fritz, "The Fourth Battle of the Atlantic," *US Naval Institute Proceedings*, Vol. 142, No. 6 (2016), pp. 18-22.
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*Commander Peter Sproule completed his command tour in HMCS St. John's in 2020 and currently serves as a member of the Directing Staff at the Canadian Forces College.*

# "We Will Not March at the Back": The Women's Royal Canadian Naval Service

**Sub-Lieutenant Lisa Tubb**

Of the casualties sustained during the Second World War by the Canadian naval services – including the Royal Canadian Navy, Royal Canadian Naval Reserve and Royal Canadian Naval Volunteer Reserve – 82% were fatal.[1] Even 75 years after its fury, the Battle of the Atlantic and the strife of naval warfare during the Second World War still hold an almost mythical lore for Canadians. The legacy of the longest continuous campaign of the Second World War conjures dramatic scenes of silent yet catastrophic U-boat attacks on convoys, and the U-boats being countered by daring and calculated counter-attacks of dazzle-painted destroyers. This battle was waged in the depths and darkness of the ocean miles from Canadian coasts in a desperate effort to meet the challenge of keeping the Allied war effort supplied with men, ammunition and foodstuffs. The trans-Atlantic convoys, U-boat attacks, the *Flower*-class corvettes and *Tribal*-class destroyers are integral parts of the story of the Battle of the Atlantic and the naval history of the Second World War. However, there is one crucial part, or rather group, which is often overlooked for its contributions during these contests at sea – the Women's Royal Canadian Naval Service.

"My parents, when I came home and said that I had joined the Navy, they weren't surprised, I think they felt it was just a matter of time, and so they were very supportive."[2] These are the words of Janet Hester Watt, whose smile and enthusiasm regarding her service in the Women's Royal Canadian Naval Service (WRCNS, also known as 'Wrens') has not faded over the years. Watt was the fourth member of her family to wear the navy uniform, following in the footsteps of her two brothers and her sister Jean, a fellow Wren.[3] The support was echoed in homes across Canada as the world was once again drawn into war. And, after 31 July 1942, a new breed of sailor began to arrive home to greet their parents with this piece of news.

In an effort to step up Canada's military response, in early 1941 the Department of Labour and all three military branches were pressed to enlist women to aid in the war effort.[4] The Royal Canadian Air Force (RCAF) and Canadian Army established separate women's divisions on 2 July and 13 August of that year, respectively.[5]

Although the air force and army established women's divisions in 1941, applications were not received or considered to fill the first class of WRCNS until July 1942.[6] However, it should be noted that the organization's roots

*Credit: Library and Archives Canada, RG 24, R112 4950992*

*A Women's Royal Canadian Naval Service (WRCNS) member looks out from Signal Hill over St. John's harbour in Newfoundland, undated.*

actually stem from the First World War, as historian Roger Litwiller points out. HMCS *Prince George* sailed on 8 August 1914 with a complement of nursing sisters, who are now recognized as the first women serving at sea with the Royal Canadian Navy (RCN).[7] For Canadian women, this was the extent of their participation with the navy during this conflict, whereas women in Britain had been able to serve and perform shore duties in the Women's Royal Naval Service (WRNS), approved by King George V on 28 November 1917.[8] The camaraderie women experienced through service in the First World War also formed a sisterhood which endured the interwar years, and many of these members then helped to reorganize the WRCNS in 1939. In 1942, after hesitation but finally accepting the need for additional womanpower, the RCN sent a message to the British WRNS saying "Please send us a Mother Wren."[9] Advice and guidance were needed to form a force of women to help shoulder the burden of the Battle of the Atlantic which was taking its toll on Canada's naval forces.

Members of the Women's Royal Canadian Naval Service formed the smallest female contingent of the Canadian military branches. But, in spite of their small numbers and their late entrance into the war effort, the effect that the WRCNS had on the war effort, and more specifically the Battle of the Atlantic, is undeniable. Women of the WRCNS served with distinction across Canada and overseas in a wide variety of duties, effectively contributing to the Battle of the Atlantic, and beyond.


Credit: City of Vancouver Archives

*A 1915 postcard depicts the coastal liner SS **Prince George**, which served as a hospital ship in the Royal Canadian Navy during the First World War and had as part of its complement the first women now recognized to have served in the RCN.*

Guiding this exploration into the WRCNS Battle of the Atlantic experience is a selection of the female voices of those who proudly served, including Vikki La Prairie, Alice Adams, Carol Elizabeth Duffus Hendry, Rosamond Greer, Jenny Pike, Janet Hester Watt and Ruth Werbin. Their voices offer a different perspective on the situation during wartime, and help us to understand the strength and determination of women who wished to serve their country in uniform.

The late arrival to the war meant little for the highly dedicated and determined WRCNS recruits entering the ranks. From the initial pool of 2,000 applications, 67 women reported to Kingsmill House, Ottawa, for basic training. Of these women, 22 became officers and also the first Commonwealth women to hold a King's commission.[10] Eventually all basic training for female recruits was located at HMCS *Bytown II*, later named HMCS *Conestoga* in Galt, Ontario.[11] Following basic training, members were assigned one of 39 ratings, or as more commonly known, trades.[12] Putting women in these trades allowed the men occupying them to be released for sea duty. This was the original idea, to provide a way to allow women into uniform, however, as the war progressed, the number of ratings expanded, and women began to affect the naval war effort through large and small acts of courage and grit.

An important first step into entering the naval service for women was volunteering and committing themselves to the alien world of military service during wartime. For those serving today, the mix of anxiety and anticipation which rests in the pit of one's stomach whenever whispers of postings or deployments arise is all too familiar. For most WRCNS, postings sent them to the coasts. Greer, a native of Vancouver, was posted on the opposite coast of the country. Charleton, a prairie girl from Winnipeg, Manitoba, was posted to Halifax, and La Prairie's training took her across two provinces, until she too, like Charleton received her posting to Halifax. WRCNS also found themselves being posted to Newfoundland, or even to Londonderry, London or Plymouth in Great Britain,

Credit: Canadian War Museum, George Metcalf Archival Collection

*Jenny Pike (née Whitehead), left, develops photographs in a darkroom alongside a colleague in an undated photo. A member of the WRCNS, she was the only woman working in the darkroom that processed the initial D-Day landing photographs.*

with HMCS *Niobe* in Scotland, and a small number went to New York or Washington.[13] In her autobiography, Greer notes that during the war, around one-sixth of the WRCNS served outside of Canada.[14]

Before taking up the watch on these postings, however, the first great hurdle new recruits faced was basic training at HMCS *Conestoga*. And not dissimilar to experiences of servicemen and women throughout the ages, each WRCNS member remembered this experience – during research on this topic, I found that the stories of basic training were the most colourful and animated parts of many WRCNS memoirs. WRCNS recruits shed their civilian clothes, identities and were immediately thrown into military life complete with early wake-up calls, tight timelines to make (or inevitably break and suffer the consequences), shared responsibilities and standards to maintain. These new recruits faced a steep learning curve when adapting to their new environment – kitchens were galleys, bathrooms were heads, floors were decks, and the training school HMCS *Conestoga* was in fact a ship, despite the solid ground underfoot.[15] On reflecting about her training, Greer comments, "There were so many things to learn! We learned how to salute … who to salute … and when to salute…. We learned to say 'Yes Ma'am' and 'No Ma'am' (and very often, 'I'm very sorry Ma'am')."[16] Greer further reflects that the instructors at HMCS *Conestoga* "taught us, organized us … and scared us half to death."[17]

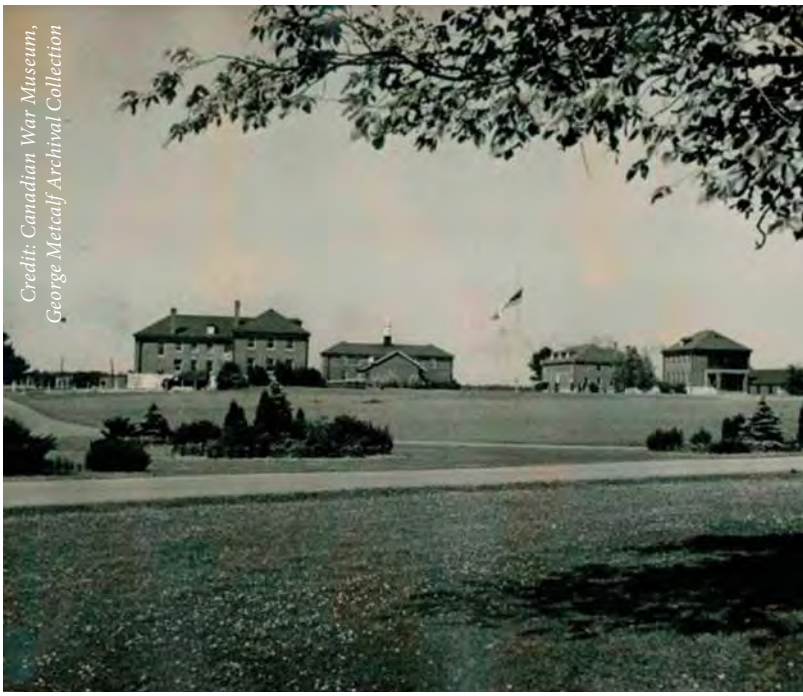
This pace of life was a stark contrast to the glorified patriotic visions about serving that recruits may have held when beginning this journey, but WRCNS members persevered. They graduated, and continued to advanced training schools, or received immediate postings, depending on their rating. For instance, WRCNS member La Prairie was employed as a visual signaller and was sent to St. Hyacinthe, Quebec. Her training prepared her to read Morse Code from incoming ships, which was delivered from great distance and at great speed, and then return instructions to guide the ships to harbour. La Prairie reflects that

> Every day, bad weather or good, we were out learning…. [In particular] it was semaphore [a system of flag signals], we had to know the whole fleet signal book off by heart. We had to, by telescope, be able to identify different flags on different ships. We were beautifully trained.[18]

On first glance, this could appear to be a typical shore duty. However, in La Prairie's experiences, these signalers were left exposed to weather, and had great risks and responsibility on their shoulders too. One shift in particular occurred during a storm in December when La Prairie stood alone on the roof of her tower, ice freezing to her eyelashes as five different ships returning home attempted to signal her while the wind drowned out her vocal instructions to her partner below.[19] Signal towers and wireless telegraphist stations in Halifax were 'womaned' solely by WRCNS members.[20]

While La Prairie and her signaler companions guided ships and sailors home, other WRCNS members prepared them for deployment and service in the U-boat-ridden, unforgiving Atlantic theatre. Duffus was called up in March of 1943 and was assigned a position performing staff officer training. These WRCNS members taught tactics to escort vessel crew members to prepare them for convoy protection duty in the Atlantic. The WRCNS officers took control of a tactical table, issued scenarios to the students and "would play the game as situations arose.... Perhaps it would be announced that there was a submarine sighted somewhere or someone had seen a ship blow up, so they knew a submarine had done that."[21]

Women also fought and safeguarded the information battlespace, like Charleton of Winnipeg who enlisted as a WRCNS with HMCS *Chippawa* in 1942 as a writer. Following training, she was posted to Halifax where she was tasked with burning secret messages along with other administrative duties.[22] WRCNS members with transmitting, receiving, coding or similar ratings were posted across the country to send and intercept messages including at HMCS *Coverdale* in New Brunswick. Another WRCNS member, Adams, who would later be anointed




*An undated photograph shows HMCS* ***Conestoga****, near Galt, Ontario, which was the training centre for new Women's Royal Canadian Naval Service members.*

Credit: Library and Archives Canada, RG 24, R112 4950817

*Signaller Irene Cheshire of the WRCNS sends a Morse Code message by signal projector in an undated photo.*

with the nickname of 'Ruddy,' joined in 1942, and was among the first group of women chosen to be wireless telegraphists. She was posted to HMCS *Coverdale*, where she engaged in the tracking of enemy submarines, and intercepting their signals in an effort to recognize patterns, and by extension, boat numbers.[23] It was here, on 30 April 1945 under the supervision of watch leader Elsie Michaels (née Houlding), that a startling message from German Admiral Karl Doenitz was intercepted. Doenitz's message being relayed to his forces declared that Adolf Hitler was dead – the intercepting operator was the first Allied military member to know this information![24]

Throughout the Second World War over 1,000 WRCNS members served overseas, and six members died in service.[25] WRCNS member Watt indicated that her journey into uniform, along with most others, was inspired out of a call to action to aid kin, neighbours and fellow Canadians at sea, and to seek adventure. These women contributed to the effort in more ways than originally thought possible, with great pride, as they were cognizant of the toll Atlantic crossings were taking on their Canadian brothers, husbands, friends and neighbours. Charleton recalls that "[w]e couldn't help but know something of that in the year 1943 because [of the] great loss of shipping at that time, in '43 and '44. But especially '43 was bad because the U-boats were over here on the Atlantic coast."[26] One day in particular, Charleton had been summoned over the intercom system to report to the office where she was tasked with recording a roll call of sailors arriving on base who had survived a U-boat attack. The memory of a particular sailor stuck with her as "[h]e said that he'd lost his parents and he had just lost his only brother who was left. He'd just lost him at sea…. I couldn't do anything about it except reach over and ... and take his hand."[27]

Working behind the scenes, the women of the WRCNS strove to give Canadian sailors the training, care and intelligence required to turn the tide and eventually dominate in the Battle of the Atlantic. And even after skirmishes in this theatre ceased, many like Greer "all but ran to reenlist for the duration of the Pacific hostilities."[28] Their war was not over and their duty was not yet done. WRCNS members continued the fight, received new cross-country


Credit: Canadian War Museum, George Metcalf Archival Collection, CWM 19790483-010_2

*Members of the Canadian Naval Mission Overseas staff in London, England, celebrate V-E Day. Second from the left is WRCNS member Lorna Stanger.*

postings in Vancouver and learned Kana, the Japanese version of Morse Code.[29] Soon, all members like Greer were released from service following the capitulation of Japan in early September 1945. Her war ended on 6 March 1946, and she recalls there was only the wake-up call of reveille, "there were no parades … no brass bands…. I knew my job was done. It was time to go home."[30]

Duffus shared a similar sentiment in a recent interview, saying that the service of the WRCNS had been largely in the shadows and has continued to stay there. She reflects, "[a]n awful lot of people don't know what the women did in the services during the war.… [I]f it weren't for what they did, a lot of things would not have been done."[31] Some members, like Jenny Pike are remembered for their refusal to be forgotten. For instance soon after the war, when told to march at the back of a Remembrance Day parade, Pike proclaimed "[w]e are women veterans, we will NOT march at the back, we're going to join the men where we belong."[32]

Members of the Women's Royal Canadian Naval Service did more than just free men from shore duties. They functioned as a fully integrated part of the Royal Canadian Navy, not just as an auxiliary force.[33] The work contributed by the WRCNS encompassed much more than shore duties and created lifelines for Canadian ships at sea, which helped keep the Royal Canadian Navy afloat in the Battle of the Atlantic, and well-supported during its existence throughout the Second World War. CNR

**Notes**

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4. Rosamond Greer, *The Girls of the King's Navy* (Victoria, BC: Sono Nis Press, 1983), p. 14.
5. Carolyn Gossage, *Greatcoats and Glamour Boots: Canadian Women at War (1939-1945)* (Toronto, Ontario: Dundurn Press, 1991), p. 35.
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8. Greer, *The Girls of the King's Navy*, p. 11.
9. *Ibid*., p. 12.
10. *Ibid*., p. 22.
11. "WRCNS - The Wrens," CFB Esquimalt Naval and Military Museum, available at https://navalandmilitarymuseum.org/archives/articles/paving-the-way/wrcns-the-wrens/.
12. Litwiller, "Women in the RCN."
13. Greer, *The Girls of the King's Navy*, p. 11.
14. *Ibid*.
15. *Ibid*., p. 33.
16. *Ibid*.
17. *Ibid*., p. 31.
18. "Vicki La Prairie: Veteran Stories - The Memory Project," The Memory Project, Government of Canada, available at http://www.thememoryproject.com/stories/1650:vicki-la-prairie/.
19. *Ibid*.
20. "WRCNS - The Wrens," CFB Esquimalt Naval and Military Museum.
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22. "Ruth Werbin: Veteran Stories - The Memory Project," The Memory Project, Government of Canada, available at http://www.thememoryproject.com/stories/2103:ruth-werbin/.
23. "Alice Adams," CFB Esquimalt Naval and Military Museum, available at https://navalandmilitarymuseum.org/archives/articles/alice-adams/.
24. When interviewed, WRCNS member Joy Kermack stated the following, "In May 1994, I was visiting my watch leader and long-time friend Elsie (née Houlding) Michaels in Victoria. She had a favour to ask. Would I choose a safe place for something she had kept all these years from Coverdale? The Canadian War Museum is now the custodian of the message received on Elsie's watch in German plain language from German Admiral Doenitz telling all his forces that Hitler was dead! Coverdale had scooped the Allies with this news. Of course, it's too late to reprimand her now. Actually, I think she did Canada a favour – it is probably the only existing record." "HMCS Coverdale," Canada.ca. Government of Canada, available at https://www.canada.ca/en/navy/services/history/ships-histories/coverdale.html.
25. Litwiller, "Women in the RCN."
26. "Ruth Werbin: Veteran Stories."
27. *Ibid*.
28. Greer, *The Girls of the King's Navy*, p. 125.
29. "Alice Adams," CFB Esquimalt Naval and Military Museum.
30. Greer, *The Girls of the King's Navy*, pp. 141-142.
31. "Carol Elizabeth Duffus Hendry: Veteran Stories."
32. Barbara Fosdick, "Jenny Pike," CFB Esquimalt Naval and Military Museum, available at https://navalandmilitarymuseum.org/archives/articles/paving-the-way/jenny-pike/.
33. Greer, *The Girls of the King's Navy*, p. 32.

*Sub-Lieutenant Lisa Tubb enrolled in the Canadian Armed Forces in 2018 and is currently stationed at RCN headquarters on the Social Media team. Studying Canadian heroes and stories during her graduate and undergraduate studies, she was motivated to educate Canadians on these important legacies. Now in uniform, Sub-Lt. Tubb tells the stories of the sailors of today and yesterday.*

# Chemical Weapons Disposal and the Scuttling of LST 3521 in 1946

**Alex Souchen**

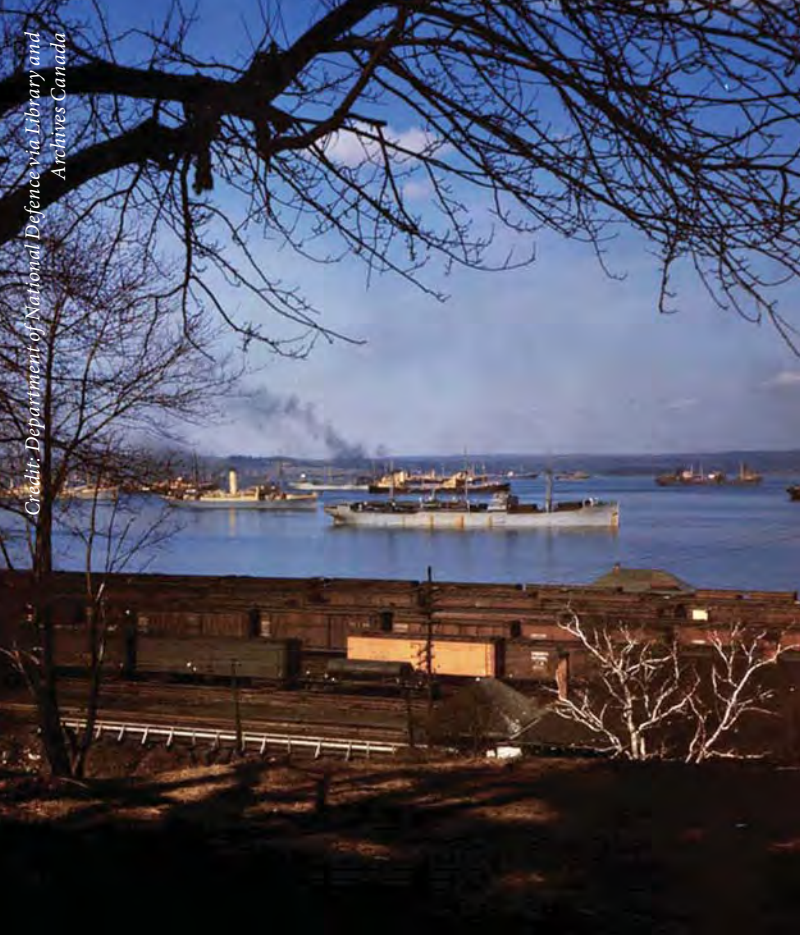
*Credit: Library and Archives Canada/Department of National Defence fonds/e011066022*

*Men manoeuvre barrels full of mustard gas in preparation for their disposal, 30 January 1946.*

Although chemical weapons are most often associated with the First World War, they also played a significant role in the Second World War. From 1939 to 1945, all belligerent states mobilized their chemical industries and invested billions of dollars in research, development and expansion across all scientific disciplines. The sinews of war, therefore, brought forth the mass production of new insecticides, like DDT and Zyklon B, as well as the deadly nerve agents Tabun and Sarin, both discovered in Germany in the late 1930s. Furthermore, the Axis and Allied powers armed themselves with the same poison gases used a generation earlier, stockpiling large quantities of asphyxiating and blistering agents, like phosgene, lewisite and mustard sulfur (commonly known as 'mustard gas' even though it does not vaporize).

During the war, chemical weapons were deployed to support combat operations in various capacities. The Japanese used poison gas and biological weapons against Chinese troops and civilians, while the British and Americans used white phosphorus and other incendiaries in bombing campaigns. Behind the lines, DDT was sprayed over vast tracts of land to control the spread of malaria and pests, which also doused ecosystems with a powerful toxicant that killed birds and insect predators. The Nazis used Zyklon B to murder millions of Jews and other innocent civilians in gas chambers. Moreover, the potential for escalation and retaliation prompted Allied militaries to conduct field training and human testing that intentionally exposed their own troops to chemical weapons, including mustard gas.[1]

Given the scale of procurement, the end of the war in 1945 caused a major disposal problem. Allied forces captured roughly 290,000 tonnes of chemical weapons in Germany, but only a fraction was needed for defence research. As well, obsolete munitions in Allied arsenals also required disposal.[2] To eliminate the captured and surplus stockpiles, Allied military leaders ordered them incinerated on land or dumped at sea. Consequently, by 1948, the Allies had dumped over 250,000 tonnes of chemical weapons (along with far greater quantities of conventional munitions) into the seas surrounding Europe. Today, scientists estimate that about 1,000,000 tonnes were sunk




*A convoy gathers in Bedford Basin during the Second World War. The area would become a key nexus for postwar demobilization.*

worldwide, with over 600,000 tonnes located in European waters.[3] From the Baltic Sea to the Coral Sea off the coast of Australia, dumpsites containing both conventional and chemical weapons now exist almost everywhere. In fact, there are several sites containing chemical weapons located off Canada's coastlines, as Canadian authorities followed these international precedents.

This article examines the postwar fate of surplus chemical weapons in Canada by focusing on the disposal of over 2,000 tons[4] of mustard gas off the coast of Nova Scotia in February 1946. It argues that dumping was one of the Royal Canadian Navy's most significant contributions to postwar demobilization, as the navy 'drowned' thousands of tons of ordnance that were congesting military depots after units returned home. Yet at the same time, nothing about dumping was easy or straightforward. On paper and in public relations campaigns, disposal appeared to be well-controlled and methodically organized: surplus mustard gas was placed on a single ship and scuttled at a location far away from the coast, devoid of fishing and economic interests. The public need not worry, because the oceans would dilute the dangers and cure the postwar storage crisis. However, in practice, as the scuttling of Landing Ship Tank (LST) 3521 demonstrates, operations could quickly turn into a debacle when circumstances and contingencies thwarted plans. This resulted in munitions being dumped haphazardly across large stretches of the Atlantic and Pacific coastlines.

The history of Canada's postwar disposal program for chemical weapons begins with wartime procurement. Canada's arsenal of mustard gas came from Stormont Chemicals Limited, a Crown company located on 308.5 acres of expropriated lands on the outskirts of Cornwall, Ontario. Built in 1942, the plant was operated by the private contractor Courtaulds Limited, under the supervision of Allied War Supplies Corporation, a subsidiary of the federal Department of Munitions and Supply. Since this marked the first time that weapons of mass destruction were manufactured on Canadian soil, there were serious deficits in production technology and domestic expertise that were only rectified by close cooperation with the United States and United Kingdom. Loans of equipment from the American Chemical Warfare Service were integral to the plant's operations, as was the engineering and technical support it offered. Canadian personnel were also sent to the United States and Britain for training, and British experts inspected the plant. Stormont Chemicals was built to manufacture both the American and British variants of mustard gas and a special section was added for filling operations. By the end of 1943, it employed 280 people working in 50 buildings, and had a weekly production capacity of 300 tons (150 tons of each variant).[5]

Although the factory never reached its full capacity, Stormont Chemicals distributed mustard gas to the Americans for experimental testing and built up sufficient stockpiles to satisfy needs in Canada. The facility in Cornwall supplied mustard gas to the Suffield testing site in Alberta, where Canada and Britain had established a gas training school and proving ground.[6] However, by the summer of 1944, the need for poison gas dwindled and the factory was placed in stand-by condition. The postwar fate of Canada's mustard gas was decided over the fall of 1945, when British, American and Soviet occupation forces started disarming Germany and Japan. Canada followed the precedents of its allies in Europe and Asia, destroying its chemical weapons by ocean dumping. Indeed, dumping was almost a forgone conclusion because the navy had been dumping conventional munitions for months.

In 1945, the Canadian armed forces faced a serious storage and logistical crisis. When the war ended, not surprisingly, the consumption of munitions and supplies tailed off, right as units returned kit to depots and shipments from factories continued arriving. Therefore, military bases became congested and quickly morphed into parking lots for all the leftover weaponry, supplies and equipment. The situation was most acute at the handful of ordnance depots spread across the country, and it took a disastrous turn at the Bedford Depot in Halifax Harbour. From May to July 1945, personnel at Bedford rapidly

unloaded the ammunition from 83 surplus naval vessels that were bound for Canada's boneyards. With the depot's entire storage capacity exhausted, they resorted to stacking ordnance outdoors and under tarps in contravention of safety regulations. On the evening of 18 July, a fire broke out and caused a chain reaction of explosions that levelled large parts of the facility, killing one person and injuring dozens more.[7]

Although this other Halifax Explosion was not as deadly or devastating as the one in 1917, it put the Bedford Depot out of commission until 1947, thereby increasing the urgency for dumping operations. All munitions recovered in the blast zone were ordered dumped 60 nautical miles south of Halifax in the Emerald Basin, a 250-metre depression on the Scotian Shelf. The destruction caused by the explosion limited the depot's storage capacity for everything else. By October 1945, the navy had assigned six vessels (HMCS *Poundmaker*, *Buckingham*, *Victoriaville*, *Middlesex*, *Eastore* and *St. Pierre*) to dumping duties. According to several inventories, these ships dumped an average of 30-35 tons per day, and maintained a weekly average of about 500 tons altogether.[8] It is also likely that these averages increased following the Liberal government's postwar budget cuts to defence spending in 1946 and 1947.[9] In that sense, dumping became an important pressure release for the logistics of demobilization, as the navy relieved the Canadian state of any continuing financial burdens for ordnance storage. This was an essential contribution that allowed the military to downsize its arsenals at a pace commensurate with the rapid discharge of personnel.

The first steps in *Operation Mustard*, the codename for the disposal of Canada's mustard gas, took place in January 1946 when five separate trains transported over 2,000 tons from Cornwall to Halifax. Workers at Stormont Chemicals spent early January coordinating with the private contractor hired to conduct the dumping (Hayes, Stuart and Coy Limited), and the Canadian Army's Directorate of Chemical Warfare and Smoke, which handled the transportation arrangements. At the Cornwall plant, mustard gas was poured into 45-gallon drums and hermetically sealed to prevent leakage during transport.

*Credit: Library and Archives Canada/ Department of National Defence fonds/ e011066024*

*Drums of mustard gas await disposal, 30 January 1946.*

The first shipment totaled 35 boxcars, filled with roughly 10,000 drums; later shipments were considerably smaller.[10] In Halifax, the drums were placed into an unfinished naval vessel that was specially retrofitted for the cargo: LST 3521 (in the primary documents LST 3521 is identified by the misnomer LST 209 likely because it was the 209th hull constructed by Canadian Vickers in Montreal; LST 209 was the USS *Bamberg County*). Following other Allied operations in Europe, the plan was to fill LST 3521 with the drums and scuttle it at a pre-designated location, well off the continental shelf.[11] A small convoy of ships would be involved: a tugboat from the company Foundation Maritime would haul LST 3521; an old army support ship HMCS *General Drury* would transport the military's disposal officers and other personnel; and the minesweeper HMCS *Middlesex* was tasked with escort duties and placed in overall command.[12]

While the preparatory work was underway, officials in Canada's Department of National Defence (DND) undertook a public relations campaign to assuage anxieties about the presence of chemical weapons in Halifax and along the railways throughout Eastern Canada. They assured reporters that every precaution was being taken, just like during the war when many tons of gas, explosives and weapons passed through the same logistics networks with few incidents. The only difference at this time was that wartime censorship had eased, so the movements were more widely known. Furthermore, officials emphasized the efficiency and safety of the scuttling operation and downplayed the environmental consequences, stating that nothing would be jettisoned near fishing grounds and that the "slow leakage [of the gas] … into the sea will not be harmful to fish."[13] In an effort to promote transparency and shape interpretations about the necessity of dumping, DND allowed local reporters to observe the operation onboard *General Drury*.

The plan seemed airtight, but appearances can be deceiving because very little went according to the plan. Even before the ships set sail, problems arose. Since mustard gas is very corrosive, it ate through the steel drums, especially because many were filled long before January and stored outdoors. As a result, when workers loaded the drums on to LST 3521, some were accidentally gassed and several minor injuries were reported.[14] When LST 3521 was finally ready, on 17 February, it was hauled from Gun Wharf, Dartmouth, and the convoy set a course toward the pre-selected position, 200 miles south of Halifax and 60 miles southeast of Sable Island (coordinates 40°N, 60°W).[15] At first the voyage appeared routine, but on the following day the convoy encountered a nasty winter gale that slowed progress and made all the reporters onboard

Credit: Maritime History Archive, Memorial University, Box 09 PF-001.1-Y25a

*The steam tug* ***Foundation Franklin*** *is shown here in a July 1933 photo next to the sinking SS* ***Marsland*** *at South Head, St. John's, Newfoundland.* ***Foundation Franklin****, built in 1918, towed* ***LST 3521*** *just over a dozen years later.*

*General Drury* terribly seasick. The weather conditions also forced the convoy's Commanding Officer and Captain of *Middlesex*, Lieutenant-Commander B.P. Young, to modify the plan.[16]

The storm prevented the convoy from reaching its destination because the rough seas made hauling LST 3521 nearly impossible. The tugboat, *Foundation Franklin*, faced a daunting challenge towing the much larger and heavier hulk, and this became more difficult as LST 3521 rocked violently in the ocean's swell. After struggling for most of the day, the convoy finally reached the edge of the Scotian Shelf, several dozen miles away from its destination. Under the circumstances and with nightfall fast approaching, Young ordered the tug's skipper to slip the tow at 21:30 hours. With LST 3521 unmanned and now uncontrolled, it had to be scuttled quickly. When the rough seas prevented the private contractor's scuttling party from boarding, Young decided to use depth charges. *Middlesex* made three runs, launching a total of three depth charges, to no avail.[17] However, at this point, the weather improved and *Franklin* placed the scuttling party onboard and they completed their job by 22:45 hours. Young was then informed LST 3521 would sink in 90 minutes, but after several hours it was barely listing. Apparently, the scuttling party had botched the job: with drums of mustard gas knocked about by the storm and depth charges, they "neglected to open the after sea cocks" and remove the covers from several holes that were bored into the decks to help it sink faster.[18]

Onboard *Middlesex*, Young grew frustrated. He was responsible for scuttling LST 3521 and its hazardous cargo, but nothing was working and his crew spent the night desperately trying to keep search lights pinned on the uncontrolled and partially-sinking ship. By late morning


***LST 3521** as photographed at 0800 on 19 February 1946.*


***LST 3521** finally slips beneath the waves with its deadly mustard gas cargo on 19 February 1946.*

on 19 February, the private contractor recommended that *Middlesex* use its deck gun to blast holes in the ship along the waterline. Without any alternatives, Young brought his ship around and opened fire at 12:40 hours, expending 400 rounds before finally sinking LST 3521 at 14:58 hours. After the ship slipped below the surface, four drums were observed floating nearby and were sunk by rifle fire from 50-70 yards. *Middlesex* patrolled the site for another hour, but finding no other drums, it returned to Halifax. According to Young, LST 3521's final resting spot is located at 42°50'N, 60°12'W in 1,350 fathoms of water.[19] The seasick reporters onboard *General Drury* saw little of the unfolding debacle, so the military's public relations campaign largely succeeded in affirming a positive narrative about the necessity of dumping and shaping public perceptions about its ability to control the disposal process.

In the 1940s, government and military officials based their munitions disposal policies on longstanding trends in waste disposal methods, even though few scientific studies were available on the behaviour of chemical warfare agents in water. Any concerns about toxicity or recovery were mitigated by perceived dilution thresholds, the depth of the water and the distance from the shore, and the limited number of alternative disposal methods.[20] However, not everyone seemed convinced, as *The Globe and Mail*'s headline for a story on the topic read: "Davey Jones Needs Gas Mask."[21] The attention-grabbing headline may have been deliberately sensationalized, but it still harboured a subtle critique: if the cargo was not hazardous, then why did Davey Jones need a mask?

## *Conclusions*

Throughout most of the twentieth century, dumping was a primary disposal method for surplus conventional and chemical weapons, and most industrialized states also used it for the disposal of radioactive waste. Canada was no exception. In 1960, the navy dumped 24,930 pounds of radioactive waste (packed in lead paint cans and encased in concrete) along with fuses and ammunition into the Pacific. Another 15,512 pounds of radioactive materials and almost 131,000 pounds of conventional munitions were jettisoned into the Atlantic and Pacific the following year.[22] Fortunately, though, growing pressure from environmentalists in the 1960s brought about stricter environmental regulations at the national and international levels. This resulted in the Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (commonly called the London Convention) in 1972. This international convention outlawed the dumping of waste from ships at sea, and in 1975 the Canadian Parliament passed the *Ocean Dumping Control Act* to ratify the treaty and better regulate ocean pollution within Canadian territorial waters.

Today, the dumping of munitions can only occur under certain emergency circumstances, but the legacies of past policies still remain on the seabed. In 2008, Notra Inc. was hired to conduct risk assessments on Canada's chemical weapons dumpsites along the Atlantic and Pacific coasts, and it concluded that they did not pose an acute risk to human health or marine environments. In fact, it determined that the water pressure imploded the drums of mustard gas (even inside the ship's hull), causing immediate dilution.[23] However, mustard gas is a liquid that does not hydrolyze easily because it forms an outer crust in sea water, and can therefore persist in marine environments for decades. Recent scientific studies in the Baltic Sea have found concentrations of degradation products and carcinogens near dumpsites that remain a concern for food webs and regular seafood consumption.[24]


Credit: Government of Canada

*HMCS **Middlesex**, an **Algerine**-class minesweeper, is shown here in this undated image. **Middlesex** played a key role in the disposal of **LST 3521**.*

The true environmental and human health impacts of underwater munitions remain a troubling question mark that requires more scientific analysis. In the meantime, the Canadian government has done very little to clean up the dumpsites in its territorial waters. The Notra report, which is heavily redacted, recommended leaving LST 3521 undisturbed and maintaining a three-kilometre exclusion zone.[25] Unfortunately, these types of guidelines promote inaction, thereby leaving the pollution of war and demobilization on the seabed, where it continues to endanger marine life, fishermen and offshore economic opportunities that were not envisioned when dumping operations occurred. Understanding more about the history of munitions disposal establishes important connections between naval and environmental history, which reveals more about the navy's ominous ecological footprints. CNR

**Notes**

1. See Edmund Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring* (Cambridge: Cambridge University Press, 2001); and Susan L. Smith, *Toxic Exposures: Mustard Gas and the Health Consequences of World War II in the United States* (New Brunswick, New Jersey: Rutgers University Press, 2017).
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# Ice Navigation and Arctic Security

**Captain Donald Gibson**

Credit: Timothy Choi

*The setting sun casts its glow on a large piece of ice floating off the southwestern coast of Greenland in May 2019.*

After decades of missed opportunities, the Canadian government and shipping industry are finally driving ahead with renewed vigour to strengthen sectors of the Canadian Arctic maritime transport and security system. In particular, they have committed to improving icebreaking and shipbuilding capabilities for northern operations. As the polar ice recedes further each summer, the demands for ocean shipping through frontier regions have increased, but the enormous risks associated with polar operations remain. Catastrophic damage to vessels and machinery, environmental pollution, or loss of life can occur due to excessive speed or lack of situational awareness while navigating in ice. Consequently, traditional contingency plans for marine emergencies may be inadequate due to remote location, harsh weather, uncharted waters and difficult terrain.

These factors will create challenges and delays for search and rescue or pollution response teams. Additional risks have been recognized by the International Maritime Organization (IMO), resulting in the adoption of the International Code for Ships Operating in Polar Waters (the Polar Code), which entered force in January 2017. One of the many goals of the Polar Code is to ensure that mariners are professionally trained to operate their ships in polar waters. Unfortunately, many of the lessons learned and best practices from decades of Arctic expeditions, scientific voyages and resource exploration have been lost through attrition and skill fade. For example, in 1958 the Royal Canadian Navy (RCN) lost its Arctic capability when it transferred the heavy icebreaker HMCS *Labrador* to the Department of Transport. The oil bust in the mid-1980s ended offshore exploration in the Beaufort Sea and, shortly after, the Cold War ended and with it the threat of Soviet attack via the north.

Canadian nautical institutions instruct seafarers according to the basic and advanced standards of certification in polar operations, but their ultimate objective should be to offer the finest polar training in the world. Moreover, Canadian Coast Guard (CCG) icebreakers and RCN patrol vessels must have the capability to monitor any ship in the High Arctic, and to escort, board, or inspect them when necessary. In order to achieve this, their sailors have to be supplied with the appropriate clothing, equipment and survival training to operate in a variety of extremely hazardous weather conditions. These issues of national interest must be reviewed at the highest levels of government now to ensure continual improvement in ice navigation, technology and maritime security in Canada's Arctic waters.

## *Safe Passage Through the Ice*

In 1970, the Canadian Parliament approved the *Arctic Waters Pollution Prevention Act* in order to regulate shipping and prevent pollution in the Canadian Arctic. This included a new map divided into 16 shipping safety control zones that are based on the severity of typical ice conditions throughout the year.[1] Certain vessels are allowed to transit inside these zones, within specific date ranges, according to guidelines commonly known as the Zone/Date System (ZDS). Transport Canada eventually recognized that the ZDS did not take into account the variable long-term climate trends, so in 1996 it introduced the more flexible Arctic Ice Regime Shipping Standards (AIRSS) system as an alternative.[2] When using this system, navigators make risk calculations to determine an ice numeral (IN) based on specific tables in this system. If the ice numeral is zero or positive, then an Ice Regime Routing Message must be sent to Transport Canada via Northern Canada Vessel Traffic Services (NORDREG).[3] If the

planned route and ice regimes are deemed appropriate, then acknowledgement of such will be sent for the vessel to proceed along that route. The ice navigator will use all available means to determine ice conditions throughout the voyage. If calculations result in a negative ice numeral, then either an alternate route, or icebreaker assistance should be considered. The Arctic Shipping Safety and Pollution Prevention Regulations (ASSPPR), which entered force in 2017, require that vessels, according to specific definitions in the regulations, must have an ice navigator onboard while navigating within a shipping safety control zone. This requirement mostly applies to tankers capable of carrying flammable liquids in bulk. The ice navigator must be fully certified under the *Canada Shipping Act (CSA) 2001*, to act as a master or person in charge of a deck watch. In addition, either they have acquired the minimum 50 days of required sea service, including at least 30 days of suitable ice navigation experience in Arctic waters while serving in that capacity, or they hold a "certificate of advanced training for [personnel on] ships operating in polar waters."[4]

Skillful shiphandling through ice requires a much higher level of knowledge and patience than that required in ice-free waters. Unfortunately, the sea time and training required by the ASSPPR for an ice navigator is only the minimum acceptable level. The Polar Code is even less specific in its goal which is "to ensure that ships operating in polar waters are appropriately manned by adequately qualified, trained and experienced personnel."[5] The practical side of ice seamanship is not something that can be learned in a classroom. Admittedly, the theory and techniques can be learned through instruction, but that is only the beginning of a long process.

Ice navigators provide assistance and guidance to the ship master so that the objectives of the voyage are carried out in a safe, efficient and economical manner, at all times conscious of the requirement to protect the fragile marine environment. After boarding the ship, the ice navigator and the master will review the passage plan of the route from departure berth to destination terminal, based on the vessel's ice-class, the latest ice charts, weather information and ice-regime requirements. Reliable ice information, in the form of charts and satellite imagery, is mostly provided by the Canadian Ice Service and the Canadian Space Agency. The master will then arrange a meeting with all of the shipboard personnel to discuss the risks, challenges and conditions expected during the polar voyage. Crew members will be instructed on cold weather precautions to prevent frostbite or hypothermia. In particular, the means of escape, evacuation and survival will be reviewed, with special regard to the storage location and condition of any additional survival equipment required by the Polar Code.


Credit: NordicBulk Carriers

*CCGS **Louis St. Laurent** escorts the ice-strengthened bulk carrier MV **Nordic Orion** through the Northwest Passage in 2013 on its way from Vancouver to Pori, Finland, with a full load of coal.*

Ice navigators will interpret the codes contained in Canadian Ice Service charts to calculate ice regimes based on concentration and stage of development of ice along the intended route. Prior to crossing the boundary into polar waters, sailing plans and ice-regime messages will be sent to NORDREG and Transport Canada at required intervals to be followed up by additional position reports throughout the remainder of the passage. It is important to note that throughout the voyage, the command structure of the vessel remains the same and, despite the presence of an ice navigator, the master is responsible at all times for the safe operation of the vessel and the prevention of pollution.

### *Foreign Commercial Ships in the Canadian Arctic*

Ice navigators guide all types of commercial ships through the Canadian Arctic. One example is the iron ore trade from Baffin Island, Nunavut, where ice navigators usually embark a bulk carrier at the last discharge port prior to the voyage north. They will then disembark on arrival at the final discharge port, which is most often in Europe, but sometimes Asia. Currently, there are no alternatives for embarking and disembarking ice navigators along the route, so they will stay onboard through non-polar waters as well. Most of the shipowners involved in this trade have already trained their own masters and officers according to the Polar Code, so this will likely reduce the demand for Canadian ice navigators.

The owners of ships that transport the high-grade iron ore from Baffinland's Mary River mine operate and manage reputable companies that have extensive experience in polar waters. Most of their vessels are ice-class Panamax bulk carriers, with capacities in the range of 70,000 to 80,000 tonnes. All of the stakeholders are conscious of the special circumstances and precautions needed to

operate safely in the Arctic, so they demand excellent performance at all times.

The first vessels arriving in July take the longest route because they must circumvent the middle pack of sea ice that drifts in central Baffin Bay. The only way to avoid this ice is to proceed up the west coast of Greenland toward Melville Bay, across towards Lancaster Sound, then southwest towards the eastern entrance of Pond Inlet. Although this route is mostly open water, it still remains infested with hundreds of icebergs, bergy-bits and growlers that have calved from the glaciers along the west coast of Greenland. Typically, the weather is relatively warm and there is ample daylight, especially during the early part of the season when it never gets dark.

Further south in Hudson Strait, some ships operate year-round in extreme conditions. In some cases the operations are difficult. For example, in February 2002, the Canadian Polar Class (PC4) multi-purpose cargo ship *Arctic* departed with a crew of experienced polar sailors on a voyage from Quebec to Deception Bay. The qualifications of the master, navigation officers and ice observer exceeded all Transport Canada ice navigator requirements for the voyage. Upon entering Hudson Strait, the 221-metre ship fully laden with mining supplies, pitched in the heavy swell surrounded by small floes of first-year ice more than a metre thick. While advancing westward, the strong tides created immense pressure ridges and hummocks resulting in fields of ice rubble with slabs of ice rafted on top of each other. Northerly winds created some open water near the Baffin Island shore, but the vessel still had to traverse across Hudson Strait toward Charles Island. Through long periods of total darkness and heavy snowfall, the crew scanned for new leads with powerful searchlights, as they worked to guide *Arctic* through the ice. When the strong ebb current turned to flood, the leads would close up, and the vessel would grind to a stop.

It was often necessary to cycle from full power ahead to full astern to keep from getting stuck (beset). This manoeuvring was critical to keep the vessel mobile while continually protecting the rudder and propeller from heavy contact with the ice. After days of tactical ice navigation through consolidated ice that extended beyond the horizon, the ship reached the entrance to Deception Bay. There lay a formidable wall of ice known as the shear-zone, where the dynamic pack ice meets the shore-fast ice of the bay. Finding a way through this barrier was difficult, not only due to the height of the ridge, but the greater draft of the ice keel below. While trying to manoeuvre in the current, the pressure on the hull was such that slabs of thick first-year ice were scraping along the starboard side from forward to aft, causing the ship to heel to port. At the same time, ice rubble plowed high up the port side, nearly reaching the main deck.

Throughout this struggle, the air temperature was about minus 20 Celsius with gale force winds. After ramming through the shear-zone into the harbour, the ship was beset only two miles from the berth. Then, the barometer plunged, and for one full day, the ship was engulfed in a blizzard with hurricane force winds, white-out conditions and minus 50 temperatures. Fortunately, *Arctic* made it through with no damage or need for assistance because the nearest heavy icebreakers were more than 1,000 miles away.

The Canadian ability to monitor shipping activity has improved since *Arctic*'s experience in 2002. Now, the

*Credit: Baffinland Iron Mines Corporation*

*An undated photo shows the port at Milne Inlet, which services the Mary River iron ore mine on Baffin Island.*


Credit: Baffinland Iron Mines Corporation

*The bulk carrier MV* ***Golden Bull*** *takes on a load of iron ore from the Mary River mine.*

Canadian Marine Security Operation Centres (MSOC) can track all shipping off Canada's coasts. They are capable of maintaining real-time situational awareness of civilian and foreign activities, such as drug trafficking and human smuggling, by using advanced technology to collect, store and analyze data in order to detect security threats. These centres are led by the RCN, and staffed with personnel from other marine and law-enforcement agencies in a 'whole-of-government' approach to maritime domain awareness.

Furthermore, there is a system for civilian mariners to report visual sightings of suspicious surface ships, potentially hostile aircraft, or submarines in northern waters. These vital intelligence sightings must be reported to the nearest coast radio station immediately upon a sighting. This plan is intended to extend the early warning coverage for the defence of North America.[6]

The IMO recognizes that the inhabitants of remote coastal communities could be affected by human activities such as shipping. It also acknowledges that operations in polar waters may pose demands on ships and their systems that are beyond those normally encountered. Indeed, these demands can be extreme, and the ice and weather conditions experienced by surface ships in Canada's polar maritime region may range from ice free to consolidated pack ice, with temperatures between plus 20 and minus 50 degrees Celsius. Seafarers who have worked in these conditions have acquired special knowledge that should be shared with others so they can understand and prepare for this hostile environment. For instance, there has already been successful cooperation between the Coast Guard and RCN to train Commanders of the new *Harry DeWolf*-class Arctic and Offshore Patrol Ships (AOPS) aboard the heavy icebreaker CCGS *Louis S. St. Laurent*.

The CCG icebreaker fleet is old but well maintained, and new ships are under construction. As well, for the first time in nearly 50 years, the RCN will have the capability to sail into the ice with its own ships. The annual joint and combined operations and security exercises north of the Arctic Circle, such as *Operation Nanook*, have also improved the readiness of the Canadian Armed Forces for Arctic operations, although there is still much to learn. Fortunately, Canada has a rich history of shipbuilders, tug and barge operators and commercial shipowners who have designed, built and operated ice-strengthened vessels. Canadian shipyards are, once again, working at full capacity in response to the demand for ice-strengthened ships. Above all, they are setting goals to become world


Credit: Cpl David Veldman, Canadian Armed Forces

*HMCS* ***Harry DeWolf*** *prepares to retrieve one of its rigid-hull inflatable boats carrying members of the 5th Canadian Division and Canadian Rangers near Bonavista, Newfoundland, on 19 November 2020.*


*The MV **Arctic** ore-oil-bulk carrier is pictured here in an undated photo by its operator, Fednav.*

leaders in polar ship construction and Arctic excellence.

Marine operations are pushing to expand the limits of the summer navigation season as the ice recedes further each year. The idea that convoys of ships will be sailing through the Northwest Passage to save time and money on voyages from Europe to Asia is not presently viable. Nevertheless, a reduction of perennial sea ice in the High Arctic may allow floes of multi-year ice, that are currently contained in land-fast ice and the Arctic Ocean, to migrate unobstructed into the labyrinth of passages, straits and channels that are collectively known as the Northwest Passage. Contrary to the belief that more open water will result in safer navigation, there will actually be a greater risk of damage due to incursions of old ice, particularly in fog. A collision with old ice by any vessel other than a purpose-built icebreaker will probably result in hull damage. Also, many of the passages are inadequately surveyed, so charted depths may be erroneous or non-existent. Damage to a ship in the Arctic must not be under-estimated, because the region is so isolated and difficult to reach.

## *Time to Reclaim Our Advantage*

There may not be much concern about maritime security risks in the Arctic now, but this could change on short notice. At the very least, we must have the ability to respond to security concerns as they develop there, and to interrogate or board any vessel suspected of illicit activity or failure to comply with regulations. The RCN has established a highly trained Naval Tactical Operations Group (NTOG) that is experienced and capable of carrying out high-risk maritime interdiction operations. The enhanced Naval Boarding Teams should be trained to operate in frigid conditions and ice, and be ready to deploy on the *Harry DeWolf*-class patrol ships during Arctic operations – when required. Hopefully, the RCN and Coast Guard will be able to position ships effectively to counteract security challenges, but this will be an immense challenge given the vast patrol area and lack of port infrastructure.

In summary, the navigation window in the Arctic is increasing each year as the areas of open water expand. Consequently, an increase in Arctic shipping will create a need for more ice navigators, ship masters and officers certified for operations in polar waters. Security risks will also increase as more foreign cruise ships and research vessels visit remote northern villages, and as foreign warships transit the Northwest Passage or other Arctic waters. Canada's maritime domain awareness system is robust, but there is a need for boarding teams on Polar Class patrol ships with the capability to intercept and board any vessel suspected of illicit activity or resistance to enforcement measures in ice-infested waters. Furthermore, the Canadian shipping industry should encourage development of a world-class Centre for Arctic Excellence to benchmark the highest standards of technological and academic performance for polar operations.


*CCGS **Jean Goodwill** floats in Davie Shipbuilding's Champlain drydock at the conclusion of its conversion into a medium icebreaker on 18 June 2020.*

The time has come for Canadians to accept these challenges with energy and determination, to promote Arctic knowledge and ice navigation excellence while protecting our northern communities, our polar environment and our Arctic sovereignty. CNR

**Notes**

1. Canada, Shipping Safety Control Zones Order C.R.C., c. 356 2018, *Arctic Waters Pollution Prevention Act*, 1970.
2. Transport Canada, Arctic Ice Regime Shipping System (AIRSS) Standard, January 2018.
3. Transport Canada, Northern Canada Vessel Traffic Services Zones Regulations SOR/2010-127 2020.
4. Canada, Arctic Shipping Safety and Pollution Prevention Regulations (ASSPPR), 2020.
5. International Maritime Organization (IMO), International Code for Ships Operating in Polar Waters, 2014.
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# Making Waves

## *A Reply to Ian Mack*

Dan Middlemiss

My original commentary, "The NSS: Flawed Premises" (Vol. 16, No. 1), was intended to point out certain flaws in the basic premises of the National Shipbuilding Strategy (NSS), and how these could influence the implementation of the strategy in practice. My purpose was not to imply that perfection should be expected in such a vast enterprise as the NSS. Despite Ian Mack's efforts to put a positive spin on the NSS in his response to my commentary,[1] I believe there remain valid grounds for concern about how the NSS was conceived and is currently being executed. To gloss over these shortcomings risks raising public expectations of success to a degree that no government undertaking of this scale can realistically hope to meet.

Let me offer a few brief observations on several of Mr. Mack's comments.

### *Early Studies*

The Mott MacDonald study cited by Mr. Mack is largely hypothetical and is based on seemingly arbitrary, untested estimates. Moreover, taken as a whole, this study seems geared to winning further contracts from Ottawa to put flesh on the assumptions contained within it.

True, First Marine International did oversee the process of selecting the two NSS shipyards, but it can be forgiven in part for having a rather weak pool of companies from which to choose. Seaspan, for example, was primarily oriented to building barges and ferries, and to refitting ships – not to designing and constructing large, complex vessels like replenishment ships and polar icebreakers. Moreover, Seaspan has clearly been struggling to build the Joint Support Ship (JSS) based on a foreign design that is more than 25 years old. The November 2020 Parliamentary Budget Officer (PBO) report analyzing the costs to Canadians of purchasing two JSS from Seaspan points out that this option will be vastly more expensive than buying two converted cargo ships from Chantier Davie (which is not a NSS-approved shipyard).[2] Further, buying from Davie would get the urgently needed supply ships to the navy sooner than those from Seaspan.

### *Canadian Surface Combatant Costing*

It may well be true that there was an early cost target associated with the original 'reference point design' of the Canadian Surface Combatant (CSC). However, it seems clear that this basic design, based on a notional 5,500 tonne ship, has long since been overtaken by a design now estimated to be in the 7,900 tonne range and which will feature many additional, advanced technological capabilities.

My basic point remains. The CSC competition was focused primarily on the design attributes of the proposed ships; this was not a competition directly focused on the costs of each submitted design proposal. The result of this approach appears to be a quite capable warship on paper, but one which is rapidly becoming, if it hasn't already become, too expensive for our politicians to accept.

With respect to the issue of affordability, one only has to consult the various PBO cost projections for the CSC to discern that the total costs are now approaching $5 billion per ship – and this before any final construction contract has been signed! I suspect that even the most enthusiastic supporters of the NSS are swallowing deeply and wondering whether the government will pay this staggering sum when much cheaper, and nearly as capable, options exist elsewhere. And note that this increasing cost trajectory was in place prior to the overall fiscal calamity now confronting the Canadian government because of the COVID-19 pandemic.

This is in stark contrast to the 'design-to-cost' approach adopted for the Canadian Patrol Frigate (CPF) selection process of the 1980s. In this latter case, costs were always the overriding priority, and this resulted in a far more deliberate appetite suppressant effect on the navy's capability aspirations and industry's desire for more Canadian content and greater profit opportunities.

### *Cost Reimbursable Incentive Fee Contracts*

While it is true that most of the current NSS contracts are of the target incentive type noted by Mr. Mack, they still do reimburse most of the shipbuilder's costs and

Credit: Irving Shipbuilding

*A model of the Canadian Coast Guard variant of the Arctic and Offshore Patrol Vessel shows differences in the stern equipment from the Royal Canadian Navy version. Two will be built to replace the current 1970s-vintage offshore patrol ships CCGS* ***Cape Roger*** *and CCGS* ***Cygnus****.*

Credit: Seaspan

*A graphic of the Offshore Oceanographic Science Vessel, which will be built between the first and second Joint Support Ships at Seaspan Vancouver Shipyards.*

reportedly at a very generous 12-15% rate in favour of the shipbuilder. Neither the government nor the shipyards have revealed the profit incentives built in to the current Cost Reimbursable Incentive Fee (CRIF) contracts, but some shipyards (and even the Shipbuilding Association of Canada at the time) have questioned whether such large profit percentages were justified for such relatively uncomplicated designs like the Arctic and Offshore Patrol Ship (AOPS). Indeed, one early study suggested that this profit fee was not warranted and was based on a much more complicated and wholly different referent design.[3] Further, it was the government's own explanation of this study that acknowledged that some contractors were 'gaming' the contracting system.[4]

### *Learning Curves, Longer Production Runs and Time Horizons*

On the issue of production learning curves, Mr. Mack misrepresents my point. He states that some productive 'learning' occurs after a run of only three ships. This is quite true, but I argued that *optimal* learning occurs at about the ninth ship in a production run. In so stating, I was relying on the findings of academic, industry and PBO studies, and most importantly, from the conclusions of the project completion report on the CPF program, Canada's last major warship construction project.[5] I am aware that there is some more recent opinion that modern, highly automated shipbuilding production lines will allow learning to occur earlier in a batch construction process. Nevertheless, I have found no studies that argue that maximum efficiencies will occur at the second or third warship. My point is that short production runs for certain NSS programs are neither efficient from a production standpoint, nor provide a solid foundation on which to build a viable domestic shipbuilding industry in the long run.

My essential point about the time period for the NSS is that we have little realistic expectation that the current 30-year construction tranche will be followed by anything other than the traditional bust phase of most previous shipbuilding programs. What comes next? How will the multi-year gap mentioned by Mr. Mack be avoided 30-plus years from now when all the current build programs are completed? Will large federal bailouts be required for the gap years before any new warships will be needed, and would such costs be accepted by the government of the day?

Mr. Mack explained in 2016 that NSS delays already amounted to 5-6 years.[6] A 2017 PBO report estimated that each year of delay in starting production on the CSC would cost the taxpayer $3.58 billion.[7] Irving had expected to begin construction on the CSC in 2020; now that start date has been pushed back by several years. To shore up and retain Irving's workforce, Ottawa has agreed to pay some $800 million to Irving for a sixth AOPS for the navy, plus part of a $15.7 billion package to build two additional AOPS plus 16 other vessels to be built by Seaspan for the Canadian Coast Guard (CCG). The CCG had no immediate requirement for the two AOPS. Mr. Mack suggests that this is all worthwhile, but if this is not propping


Credit: Mass Communication Specialist Seaman Darcy McAtee, US Navy

*The **Arleigh Burke**-class destroyer USS **Bainbridge** DDG 96 fires an SM-2 Block IIIA long-range air defence missile in the Atlantic Ocean on 18 November 2018. Canada received approval from the United States to purchase 100 rounds of the latest Block IIIC variant of the missile for the Canadian Surface Combatants.*

up the Canadian shipbuilding industry, then what is it?

Yes, short, stop-gap, make-work production contracts may help to plug the leaks that have occurred in certain NSS projects to date, but the more important point again is that such minor production runs are not going to win a competitive edge for Canadian shipbuilders in the highly contested global marketplace. There is almost no chance that foreign navies will be lining up to buy a much delayed and heavily 'Canadianized' variant of a decades-old, third-party supply ship design. In short, this is not a winning technology strategy that Canada should be backing as the cornerstone of a sustainable Canadian shipbuilding industry.

### *A Final Observation*

To conclude, overall I agree with much of what Mr. Mack says in his response to my original commentary, and I have always found his writings to be both illuminating and valuable. However, at the risk of over-simplifying Mr. Mack's views, I find that his main argument is that we are managing to muddle through with respect to the NSS, and that this should make us feel good somehow. Perhaps that is true, but as a friend of mine recently observed, and as various PBO cost analyses starkly portray, when it comes to the NSS, feeling good is costing Canadians an inordinate amount of money. CNR

**Notes**

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2. Ottawa, The Parliamentary Budget Officer, *The Joint Support Ship Program and the MV Asterix: A Fiscal Analysis*, 17 November 2020.
3. Terry Milewski, "Ottawa was Warned about 'Very High' Price for Arctic Patrol Ships," CBC News, 19 September 2013.
4. Ottawa, Public Services and Procurement Canada, "Executive Summary of the Review of Canada's Contract Cost Principles and Profit Policy," last modified 13 November 2019.
5. See for example, Ottawa, The Parliamentary Budget Officer (PBO), *The Cost of Canada's Surface Combatants*, 1 June 2017, pp. 12-14; David Peer, "Realistic Timeframes for Designing and Building Ships," *Canadian Naval Review*, Vol. 9, No. 1 (2013), pp. 7-8; and Ottawa, Department of National Defence, DGMEPM, *Canadian Patrol Frigate Project: Project Completion Report*, 27 July 2005, Figure 10-16, p. 101.
6. Ian Mack, "A Basic Primer on Naval Shipbuilding," Canadian Global Affairs Institute, February 2018, p. 3.
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## *MV Asterix* versus JSS: Replacing Canada's AORs

Poseidon

As *CNR* readers will know, it has been a long struggle to acquire new Underway Replenishment Ships (AORs) for the Royal Canadian Navy (RCN). HMC Ships *Protecteur* and *Preserver* were commissioned in 1969 and 1970 respectively, and were expected to be replaced after 30 years


Credit: Canadian Armed Forces Twitter

*The bulbous bow of the first Joint Support Ship was delivered to Seaspan Vancouver Shipyards in late October 2020. This piece was assembled by Ideal Welders in Delta, British Columbia, and barged to the shipyard where it will be welded to the rest of the hull.*

of service. Time passed as they proved their worth on many occasions during natural disasters abroad, peacekeeping missions, supporting task group operations during the post-9/11 *Operation Apollo*, as well as normal NATO and national readiness exercises. With time they began to show their age, for example a refit-completion delay meant that *Preserver* was unable to support *Operation Katrina* in 2005 and a few years later was unavailable to deploy to hurricane disaster relief in Central America due to electrical and propulsion issues. More breakdowns followed, corrosion was found in both ships, and a major engine-room fire in *Protecteur* in February 2014 led to an announcement that both ships would be paid off for disposal and they have since been scrapped – without replacement!

I sailed in *Preserver* when she was quite new, and have experienced the outstanding support the AORs provided to single ship and task group operations on many occasions. They were great ships and well-regarded in the RCN and by the other navies with which Canada works at sea. They should have been replaced many years ago – imagine yourself with a 1969 car in 2014, trying to get it through just one more Ottawa winter without breaking down!

There have been many plans to replace the AORs – does anyone remember the Afloat Logistics Support Capability

Credit: Davie Shipbuilding

*MV **Asterix** is seen here having its hull painted as part of its conversion into a replenishment vessel at Davie Shipbuilding, June 2017.*

(ALSC) project in the 1990s? This concept for a multi-purpose vessel evolved into the Joint Support Ship (JSS). The idea was that the ALSC/JSS – primarily intended to provide underway replenishment for the Canadian fleet – could also be more flexible if provided with the additional space and capacity to transport soldiers, army vehicles, sea containers full of materiel, landing craft, and be fitted with communications capabilities to provide command and control for joint and combined operations. The navy thought there would be broad support across the Canadian Forces for multi-purpose ships which could do more than just underway replenishment. However, there was concern that such a ship would be so useful doing other Canadian Forces roles that it might not be available when the navy needed it, therefore at least three such ships would be needed. Unfortunately, the cost premium for a true Joint Support Ship did not make it past the dreaded bean-counters. Two JSSs are indeed on order from Seaspan Shipyard in Vancouver, but they are really just modern AORs. There will be little in the way of 'jointery' built into these ships compared with previous plans when they emerge from the builders in 2023 or so. Yes, there will be naval support available for joint operations, but it will have to be done in a relatively ad hoc manner.

But enough of this rant – what about the recent report by the Parliamentary Budget Office (PBO) on whether Canada should have purchased two merchant ships modified for AOR duties, saved quite a lot of money, and taken delivery of two support ships much more quickly?

An Interim AOR, the modified container ship *Asterix*, has been leased from Federal Fleet Services after its conversion at Davie Shipyard in Lauzon, Quebec, as part of Project Resolve. MV *Asterix* has a civilian crew to operate the ship, and naval personnel to conduct replenishments at sea, operate and maintain helicopters, and provide medical and stores support to ships in company. Since entering service in early 2018, *Asterix* has been a considerable success. The ship's availability has been outstanding and her performance compares favourably with that of the recently scrapped ships. With the benefit of 20/20 hindsight, it could be argued that Canada should have acquired two such ships (PBO estimates a cost of $1.4 billion Canadian total), and not ordered the two JSS vessels from Seaspan (estimated cost C$4.1 billion total).

It surely is a moot point at this stage as Seaspan has finally started building the first JSS. Would it be cost-effective to cancel JSS and make do with two converted rather than purpose-built ships? Would there be capability shortfalls?

In terms of cost-effectiveness, if we had trialled the concept of modifying merchant ships, found that it worked well, and then with that knowledge ordered two modified ships – without ordering new vessels – perhaps it would have made sense. However, if we now had to pay a sizeable penalty to cancel the Seaspan contract, especially after the cancellation of the Arctic icebreaker contract at Seaspan in 2019, the financial savings would be adversely affected. As well, I think it would be a non-starter politically to take such a large project away from that new West Coast shipyard.

In terms of capability, I think the two Seaspan ships will be more capable than *Asterix*. They are based on the design of the German Navy's Improved *Berlin*-class, and they have proven to be very successful AORs. They will probably be in service well into the last half of the century as we squeeze every ounce of life out of our government

fleets: just look at the examples of HMC Ships *Iroquois* and *Protecteur,* and CGS *Louis S. St-Laurent* (now in her 52nd year of service).

Ideally, MV *Asterix* will continue to be leased or purchased to provide the flexibility of a third ship. There is no doubt that modifying merchant ships to perform a range of support roles for the RCN can make a lot of sense! Maybe that lesson can be remembered, and implemented when appropriate in the future. CNR

## *Time to Embed a Fire Safety Culture*

Carl Stephen Patrick Hunter[1]

Although the value of marine assets is increasing rapidly, there is great pressure everywhere to cut costs. Often, cheap fire systems only minimally comply with fire regulations and there are few qualified engineers who are experts on the subject matter. This creates an environment in which a 'safety first' culture onboard ships remains both unpursued and unrewarded. Routine maintenance of fire safety systems can be overlooked either because it is difficult and the crew unqualified to test the systems, or maintenance is given insufficient attention by the owner of the system that built and installed it. Fire systems are often out of sight and out of mind, and they are located in some room which only the maintenance contractor visits, if at all. However, the neglect of continuous monitoring of extinguishing systems is to the peril of the occupants of the ship and at the risk of crippling financial and reputational loss if a ship experiences a fire.

Safety of life primarily, then of cargo and asset, is critical at sea. Fire safety is especially so. Yet despite this, gaseous fixed fire extinguishing systems are often overlooked, and tend to be misunderstood at all levels. Gaseous systems are checked for contents annually because they are pressurised and anything that is dynamic is subject to leakage. But an annual check fails to deal with the probability of discharge for the 364 days between certification checks.

There have been several incidences of fire onboard ships in the recent past. Perhaps the most significant is the fire on board a US Navy ship in July 2020 in San Diego. USS *Richard Bonhomme*, an amphibious assault ship, experienced a fire during maintenance. The fire burned for five days. It injured 68 military and civil personnel. It also took out of service a core strategic asset of the US Navy. The top USN acquisitions official said, "[a]nyone who steps aboard our ships must be ever vigilant about ensuring fire safety. I urge you to use the recent fire to ensure that our work spaces are clean, that unnecessary clutter is removed, that all fire safety measures are being followed and that there is unrestricted access to firefighting and damage control equipment."[2] Excellent, you may think. But regardless of the reason for the fire itself, a reason that the fire became uncontrolled was because the ship's fire suppression system had been shut down and its compartment doors left open. For maintenance.

Fires are not the only danger when gaseous fire systems are not understood or maintained. In August 2011 there was accidental discharge of carbon dioxide from a fire suppression system onboard SD *Nimble* resulting in

*Credit: MC2 Austin Haist, US Navy*

*A fire that began in the well deck of the amphibious assault ship USS* ***Bonhomme Richard*** *in July 2020 made its way through much of the ship's interior while pierside at Naval Base San Diego. The ship has since been deemed a total loss and will be scrapped despite just finishing a major refit to allow it to operate F-35B aircraft.*


Credit: MC3 Jackie Hart, US Navy

*Damage Controlman 1st Class Justin Christensen inspects an actuating station on the destroyer USS* ***Farragut*** *DDG 99 while at Port Khalifa, Abu Dhabi, on 8 July 2015.*

serious injury to a service engineer at Her Majesty's Naval Base Faslane. In September 2004, in Hong Kong a routine inspection of the fixed carbon dioxide (CO2) fire extinguishing system led to the death of four officers. In February 2015, in Twentynine Palms, California, 22 US Marines were injured when a Halon-containing fire extinguisher went off. And in November 2008, at least 20 people died in an accident on a Russian nuclear submarine when a fire extinguishing system was activated by mistake.

For a gaseous extinguishing system to function, whether liquefied (such as CO2, NOVEC™ 1230 or FM-200™) or non-liquefied (Nitrogen or Inergen), you need two things. First, you need sufficient contents to generate the design concentration required to extinguish the fire. Second, you need 'compartmentation' integrity so that the extinguishing gas is contained within the space on actuation (which is in the event that a fire suppression system has to release its contents). Without both there is a risk that fire event will escalate.

The fire safety engineering industry has worked like this since gaseous systems were first developed. In 1924 the Walter Kidde Company developed the first CO2 extinguisher and in the 1960s DuPont developed the first Halon system. In the 1990s DuPont developed 'clean agents' to replace Halon, which was banned under the Montreal Protocol signed in 1987. After that came the use of natural un-liquefied gases. What unites all of them is that they are highly pressurised – some of them up to 300 Bar, or over 4,350 pounds per square inch (PSI). And anything that is pressurised can leak. If they lose more than 5% the cylinder has to be refilled.

So how can you test to make sure that both conditions are met? To check the contents of the cylinders, you can shut the system down, dismantle it and weigh each cylinder of extinguishing gas. Then you can re-install each of them. There can be 600 45 kilogram cylinders on a commercial ship, 100 on an offshore platform, 100s in a Data Centre, and 100-200 cylinders in a warship, depending on the size. It takes two licensed fire technicians 15 minutes to do this, per cylinder. On a good day.

What about compartmentation? For the compartmentation integrity, you can pressurise the compartment space, either by air or water, and see where it leaks out. Since the principal reasons for ship loss at sea remains sinking and fire, all ships, offshore oil and gas platforms, even offshore wind turbines, are built keeping the need for compartmentation in mind. Below the waterline there are watertight compartment doors, and the areas between the watertight bulkheads containing the electrical cabling are also supposed to be watertight. These are designed to maintain compartmentation integrity, not just to prevent water ingress and sinking but to stop fire passing between the compartments too.

But how do you know that the compartments are watertight? One way to test them is to fill them with water and to learn at what 'head of water' the bulkhead collapses, or the watertight compartment door bursts. But it is not very practical to do this. Another method is to pressurise the compartment by positive pressure and see where it leaks. This is all grand … on a cool calm day when no one is inside the ship. And it's even better in a lab.

But these perfect conditions rarely occur. Normally, ships are using gaseous fire systems that have been used for many years and are tested inadequately. It is as if there has been no technological advancement. So accidents keep happening, fires keep hurting and destroying. And after each incident, regulations are gently modified. And this all happens at a time of the highest-paced technological change the world has ever seen.

A bat does not fly through a forest at night by sight. A whale does not communicate hundreds of miles by using Morse Code. Submarines rarely see their adversaries or even the sea that they glide through. The blind 'see' by hearing sound and, in the above examples, it is the use of sound beyond our audible range that enables them to hear the ultrasonic sounds that others cannot hear.

A cylinder containing a 'clean agent' is in itself acoustic. Like a bell. A compartment is a room. Unless it is a chamber designed to completely absorb reflections of either sound or electromagnetic waves, it reflects them. And its leak sites let them pass through. So just as a bat, a whale or


Credit: Coltraco Ultrasonics

*An ultrasonic indicator made by the author's company is shown here measuring the amount of liquid remaining in a marine fire suppression system.*

a submarine uses ultrasound to hear the sounds that others cannot hear, so can the fire system industry use ultrasound to test both the contents of gaseous extinguishing systems *and* the compartmentation integrity of the spaces that they are meant to be held in.

Ultrasound is not new. There is a British legacy in ultrasound that began in 1916 when the Admiralty used it to hunt enemy submarines. But it has taken over 80 years for the fire industry to use it in the portable and constant monitoring of gaseous extinguishing systems and the compartment spaces they protect.

In the naval sphere fire risk management is key to the safe operation of high-value assets. Let's put words into action, and create a safety culture by constantly monitoring our extinguishing systems. To those of you who do it, I salute you. CNR

**Notes**

1. Carl Stephen Patrick Hunter OBE is Chairman of Coltraco Ultrasonics, a manufacturer of ultrasonic monitoring equipment.
2. James Geurts, Assistant Secretary of the Navy for Research, Development and Acquisition, "Navy Memo to Shipbuilders, Maintainers on Fire Safety After USS Bonhomme Richard Blaze," 24 July 2020, published in USNI, 27 July 2020, available at https://news.usni.org/2020/07/27/navy-memo-to-shipbuilders-maintainers-on-fire-safety-after-uss-bonhomme-richard-fire.

## *The Canada-US Defence Relationship*

Emmanuel Akinbobola

Despite a somewhat rocky four-year period of Canada-US relations, the defence framework hasn't changed and the defence relationship continues to be stable. Recent years have illuminated several key aspects of the defence model and illustrated that it can adapt to global issues. The unveiling of the Naval Task Group to augment the navy operating plan and presence in North America was a new initiative, and under the 2017 Canadian defence policy, *Strong, Secure, Engaged* (SSE), there is an indication that the relationship with the US military remains solid and, importantly, that it is evolving. The Canada-US policy has gone beyond simply a *defence* relationship to a broader *security* relationship.

An example of how the relationship remains stable was the participation of Canada and the United States in the exercise RIMPAC that took place in August 2020. The naval exercise brought together the navies of Pacific countries for a maritime exercise. Although this initiative dates back to the 1970s, the 2020 iteration took place despite the COVID-19 pandemic and a record-breaking number of personnel attended the exercise.[1] The United States and Canada continue to strengthen defence partnerships that transcend geographical proximity.

An example that illustrates the expansion from defence to security can be seen since 2011 when Canada implemented the Beyond the Border initiative.[2] In addition to the traditional defence relations involving the military, one of the main actors here is Public Safety Canada. The initiative includes elements such as:

- enhancing understanding of the threat environment through joint assessments;
- sharing information and intelligence in support of law enforcement and national security;
- cooperating to counter violent extremism in both countries;
- enhancing cross-border law enforcement;
- cooperating on national security and transnational criminal investigations (including the Canada-US Shiprider program);
- providing interoperable radio capability for law enforcement actors;
- enhancing cross-border critical infrastructure protection and resilience;
- protecting government and digital infrastructure;
- expanding joint leadership on international cyber-security efforts;
- enhancing collective preparedness for health security threats (including chemical, biological, radiological and nuclear emergencies); and
- harmonizing cross-border emergency communications.[3]

This policy supplements the existing framework of peace and security between the neighbours. With the Beyond


*Canadian Prime Minister Justin Trudeau shakes hands with Mexican President Enrique Peña Nieto while US President Donald Trump looks on at the signing of the 'new NAFTA' on 30 November 2018 at the G20 summit in Argentina.*

the Border initiative, the Canada-US mutual partnership has evolved to counter asymmetric challenges within their geographical territory and outside of it.

The Canada-US defence alliance is at the frontline of combating multifaceted challenges, thus this partnership requires a continuous approach to meet these evolving threats. Today, response to threats requires meticulously integrated, collaborative strategies involving a diverse range of partnerships with the United States. To maintain the momentum, modern intelligence-gathering methods from both Canada and the United States with effective dissemination of intelligence is imperative. Counter-intelligence can prevent threats such as terrorist attacks at home and abroad. This is why the strategic alliance between Canada and the United States remains relevant.

There are a variety of elements to the Canada-US defence relationship. The longstanding Canada-US partnership is reliant on a formidable, layered foundation such as the Military Cooperation Committee (MCC), and the Permanent Joint Board on Defense (PJBD). The PJBD was founded in 1940 to facilitate high-level bilateral meetings with the highest diplomatic and military ranking officers from Canada and the United States to provide policy advice on broad military subjects. The PJBD is equipped with a direct channel of communication to the highest office in both countries (Canada's Prime Minister and the US President). Military consultations and policies are treated with the urgency they deserve relative to national and continental objectives. The importance of the PJBD cannot be over-emphasized. It is strategically positioned in sustaining the unity of defence between the United States and Canada.

As a gesture of firm commitment to foster this partnership, parallel to the PJBD, the MCC was created in 1946. Its mission is to develop and coordinate Canada-US military defence planning. The MCC further facilitates and coordinates the military connection between the United States and Canada with a direct reporting channel to the Canadian Chief of the Defence Staff and the US Joint Chiefs of Staff to recommend joint military courses of action.

Also, the United States and Canada are members of the North Atlantic Treaty Organization (NATO), a transatlantic alliance formed in 1949. Their membership serves as a vital component of a broader spectrum of military partnership in the defence of Europe. The US-Canada duo in NATO epitomizes the long-lasting defence partnership, including joint military exercises, that exists between the two countries.

The final defence institutional element to be mentioned here is the North American Aerospace Defense Command (NORAD), headquartered in the United States, with other operating bases in Canada and the United States. It was formed by the United States and Canada in 1958, replacing the Continental Air Defense Command (CONAD), as a strategic defence partnership that would be key in defending North America from the Soviet Union. This initiative emphasizes shared responsibilities and cooperation, and solidified the role of the PJBD and other defence initiatives between the two countries. As well it provides a fundamental basis for increased military and intelligence alliance in the North. The joint agreement obliges both countries to contribute intelligence, capability (eg., alert ready aircraft) and human capabilities. In 2009, NORAD increased its framework to include the Canadian Joint Operations Command and the US Northern Command. The Tri-Command Framework, which focuses on northern reconnaissance, has proven that bilateral defence relationships can integrate innovative technology and machinery to achieve northern continental defence.

The US and Canada military alliance is the epitome of a partnership forged out of trust, mutual respect and most importantly shared objectives. It is a relationship that thus far has withstood the test of time and pressure in the face of adversity. The response to the 9/11 attacks, for example, involved a military campaign in Afghanistan. This large-scale operation required a coordinated military operation that had not recently been experienced.

As a result of the longstanding defence relationship, there is seamless interaction and joint military effort between

Credit: MS Dan Bard, Canadian Forces Combat Camera

*HMCS **Regina**, sporting her Second World War commemorative camouflage scheme, sails behind the American amphibious assault ship USS **Essex** LHD 2 during RIMPAC 2020 off the Hawaiian coast, 21 August 2020.*

the United States and Canada. The military cooperation hopes to detect threats, deter enemies and defend the continent. As hostile acts continue to evolve and the perpetrators use complex means, it is imperative that Canada and the United States build an impenetrable defence system. This requires that the security and defence alliance becomes stronger than ever. This falls directly under the Beyond the Border policy, as well as *Strong, Secure, Engaged*, in operationalizing the 'Anticipate, Adapt and Act' framework of Canada's defence vision. This fits with US defence policy, including intelligence gathering, training, exercises and other mechanisms.

The various security and defence elements discussed here depict an interwoven defence and security vision between the United States and Canada beyond political crosswinds. The fundamentals of a safe continent and a strong military capability are mutually shared priorities of both countries. CNR

**Notes**

1. "Royal Canadian Navy Representing Canada at RIMPAC 2020," DVIDS, 17 August 2020, available at https://www.dvidshub.net/news/376203/royal-canadian-navy-representing-canada-rimpac-2020.
2. Public Safety Canada, "Beyond the Border: A Shared Vision for Perimeter Security and Economic Competitiveness," 2011.
3. *Ibid*.

## *The Canadian Navy and Human Security in the Arctic*

Gabriella Gricius

Originally proposed in 1994 by the UN's Human Development Report, the concept of human security has greatly enlarged the way many scholars and policy-makers think about security. Human security provides a framework for a broader understanding of security threats. Rather than focusing solely on traditional threats to states – such as a military threat – a human security framework can include other potential insecurities such as, for example, transboundary pollution, climate change, ecological degradation, food security and communicable diseases. This comprehensiveness is one of its main benefits as it brings together many different security issues under one agenda. The ultimate goal of human security is to protect people rather than states. Most scholars agree that there are two forms of human security: narrow and broad. While narrow human security only encompasses 'freedom from fear' and focuses on conflict and violent threats, a broad human security approach also includes 'freedom from want' and incorporates a wide range of what constitutes security such as access to food or water.

From a military perspective, human security offers an interesting dilemma. On the one hand, it allows a more comprehensive approach to addressing threats and permits a more nuanced understanding of security. On the other hand, the military is an agent of the state and therefore emphasizes state security above people. It is important to consider that a navy, and all military forces, do what the government orders them to do. However, a military could adopt a narrow human security lens that considers an enlarged idea of what security encompasses such as violent threats, climate change, natural disasters, or peace operations to protect civilians.

As one of the original states promoting human security as a guiding principle of foreign affairs, Canada presents an interesting case for looking at human security in


Credit: Cpl David Veldman, Canadian Armed Forces

*The Arctic and Offshore Patrol Vessel (AOPV) HMCS* ***Harry DeWolf*** *uses its stern crane to lower its landing craft in Bedford Basin, 19 October 2020, during sea trials. AOPVs are equipped with enclosed lifeboats for search-and-rescue missions, as well as a landing craft that can participate in humanitarian assistance/disaster relief in locations where port infrastructure is lacking.*

the military. Although human security is no longer the buzzword that it once was, it played an important role in changing the orientation of Canada's foreign policy. Given the history of incorporating human security into governance, it is worth asking the question of whether this policy trickled down to naval policy. Does the Royal Canadian Navy (RCN) adhere to human security principles today? More importantly, should an institution such as the RCN adopt human security as part of its principles, or is this outside its mandate?

### *Canada's Adoption or Lack Thereof of Human Security*

Former Canadian Minister of Foreign Affairs, Lloyd Axworthy, introduced human security to Canada in 1996 as a guiding principle for Canada's foreign policy. Among other things, this meant support for humanitarian law, the inclusion of civil society into the policy-making process and banning landmines. Originally the Canadian vision of human security was broad in nature, taking into account both violent and non-violent threats. However, that changed by the late 1990s. During this period in Canada, the financial climate meant that human security was relegated to focusing on politically feasible goals. These included a focus on public safety, supporting citizens in war-affected contexts, conflict prevention and governance. Importantly, these goals all had to do with threats related to violent threats or conflicts. Human security took even more of a backseat in Canadian policy with the election of Stephen Harper and the Conservative Party in 2006. The Conservative government moved the needle back to a focus on traditional security and even with the Liberal government, headed by Justin Trudeau, elected in 2015, there has been no substantive shift back to a broader way of conceptualizing security that focuses on people rather than the state.[1]

Although human security is still mentioned occasionally in policy documents, Canada's conception of human security today is generally narrow and state-centric. If it follows a human security approach at all, it is a focus on broader security threats (i.e. climate change) but as this relates to violent conflicts and consequences of these security threats rather than a more holistic understanding of security.[2]

When it comes to the Arctic, scholars disagree on whether Canadian policy currently includes a focus on human security. Some claim that there are implicit expressions of human security, for example Canada's Arctic Foreign Policy and Canada's Arctic and Northern Policy Framework include discussion of environmental protection and social and economic development.[3] However, others argue that Canada's Arctic policy supports state-centric security and that while some aspects of human security may be present, they exist only to explain security policies that originate from second-order phenomena (i.e., climate change) rather than taking a people-centred approach.[4] Will Greaves, for example, argues that because Canada takes such a narrow human security approach, its policies exclude insecurities in the Canadian North that do not come from violence.[5] Thus, in the opinion of some analysts, Canadian Arctic policy prioritizes sovereignty over all other policy areas.

### *Is the RCN Using a Human Security Approach?*

Before discussing navy documents, it is important to examine Canada's overall defence policy, *Strong, Secure, Engaged*, adopted in 2017. While this policy overwhelmingly focuses on traditional security threats, the policy notes in many different chapters that the Canadian Armed Forces (CAF) must also respond to the upcoming security threat of climate change, severe natural disasters, as well as provide humanitarian assistance and conduct search-and-rescue operations.[6] Further, the CAF has provided training with the aim of empowering women and girls in Africa, and helps to counter the illegal movement of people, drugs and other transnational organized crime in the Americas.[7] This suggests that while the CAF may not

focus on the individual over the state, it is taking some cues from human security to broaden the possible list of threats. Notably, there are some indications that as the security landscape changes so too will that list of threats. Although not specifically named as a threat under the purview of the CAF now, *SSE* acknowledges that in the future, the CAF may need to support civilian organizations after a major disruption within critical infrastructure, such as a cyber attack.[8] In short, Canada's current defence policy does address some comprehensive security threats. These threats generally fall under a narrow reading of human security as they almost all focus solely on violent threats. The same trend is evident in documents published by the RCN.

In the RCN's Strategic Plan (2017-2022), the main focus of security is state-centric issues including the evolving balance of power, the return of major power competition, and the emergence of challenges to a rules-based territorial order.[9] In short, this document emphasizes traditional security and military threats. However, while there is no question that the state is emphasized rather than the individual, the document also focuses on capacity-building measures, search-and-rescue operations and humanitarian aid.[10] The question of climate change is addressed as it relates to the future of the naval structure and ship design, but not as a catalyst to re-imagine Arctic security. This follows Canada's tradition of narrow human security that broadens the realm of what could be a security threat and should be addressed by the navy.

In the RCN's *Leadmark 2020*, the emphasis on traditional security over human security is not as clear. *Leadmark 2020* describes the development of Canadian policy, marking the relevance and entry of human security into Canadian foreign policy. The document claims that "Canada is made more secure by seeing to the resolution of global problems at their source, before they can expand to threaten the Canadian heartland…. [T]he notion arguably is a driving impulse of human security initiatives."[11] While the focus is still notably on the state, rather than people, *Leadmark* takes into account the importance of a broader definition of security, showing that it "signifies not only the ongoing vigilance of the Canadian Forces [CF] towards armed aggression by foreigners against the territory of Canada and its allies, but the CF's continued deployment overseas in regional crises."[12] This definition fits into a fairly narrow reading of human security as it leaves out the focus on individuals but it does broaden the definition of security. Similarly, Canada's Arctic and Northern Policy Framework addresses human security in a narrow sense. The concept is mentioned in connection


*Credit: Cpl Aydyn Neifer, Combat Camera*

*A CC-138 Twin Otter delivers supplies to a Canadian Ranger patrol group on Sherard Osborn Island, Nunavut, during* ***Operation Nunalivut*** *on 14 April 2013.*

with environmental security. In other words, human security is used by these policies to promote a broader conception of security than traditional conceptions, but one that focuses on violent threats (a narrow view) rather than 'freedom from want' (a broad view).

Is it feasible for a state-centric military force to adopt a human security approach that emphasizes individuals above the state? Perhaps not. However, both RCN documents and the overall defence policy do propose broadening the idea of security to include the consequences of climate change, environmental security and humanitarian assistance operations. Furthermore, since 2007, the Canadian government has organized an annual joint Arctic military operation, *Operation Nanook*, which has helped the navy and other members of the CAF – as well as, notably, the Canadian Rangers – practice responses to poaching, oil spills, grounded cruise ships and other unconventional threats.

Continuing to centre naval policies around a narrow human security approach could have many benefits. Such an approach could, for example, allow the RCN to focus on emerging risks and the root causes of vulnerabilities rather than responding to purely inter-state conflict and competition. Further, the RCN could work on strengthening local capacities in, for example, the Canadian North, which could lead to increased well-being and overall resilience to the changes anticipated from climate change. This could include working together to create food and

water security policies within the changing Arctic Ocean ecosystem. With the melting of the polar ice caps, navigation will also change. This presents an opportunity for the navy to work with Indigenous Peoples to learn from traditional knowledge and cooperate on better navigation and search-and-rescue policies. The RCN could also cooperate on addressing transnational crime in the Arctic because, as the Arctic becomes more navigable, criminal organizations may try to use those waterways for illicit activities.

While the navy acts under orders from the Canadian government, the 2017 defence policy shows that there appears to be a trend of broadening what is considered a security threat. The form of human security that the navy would practice would certainly be a narrow framework. However, even the smallest step makes a difference. Taking a broader approach to security would allow the navy to restructure its approach to security in a way that means its goals will be more comprehensive. In other words, rather than trying to put out little fires before they grow into larger fires, the navy could help prevent fires from sparking in the first place. CNR

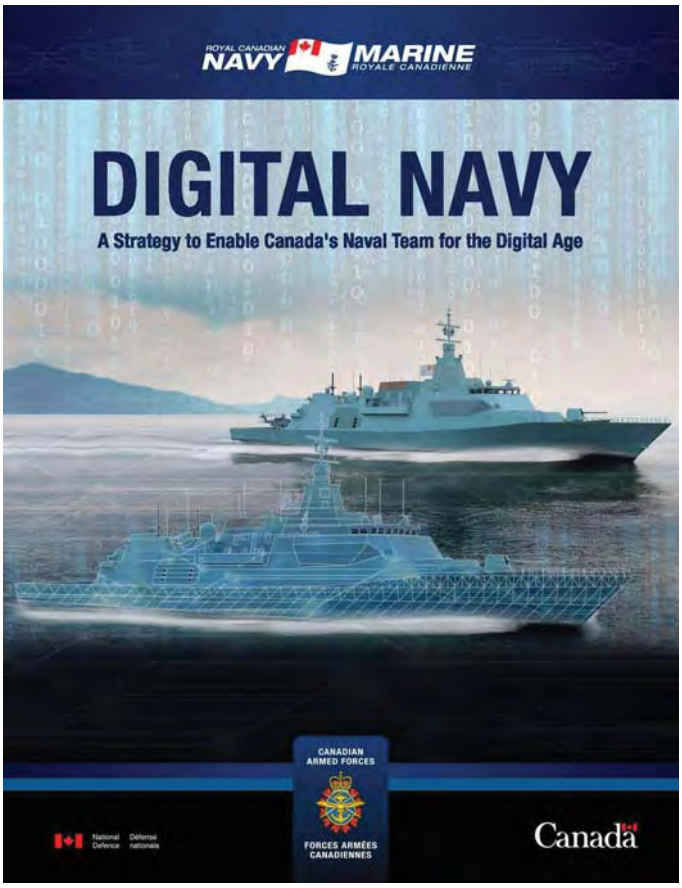
**Notes**

1. While the precise language of human security may have largely disappeared in recent years, *internationalism* has taken its place. Internationalism in foreign policy promotes multilateralism, cooperation and following international law and humanitarian values as the best way to attain a peaceful world. See Melissa DeJong, "Human Security and Canadian Foreign Policy: The New Face of Canadian Internationalism," Simon Fraser University, 2011.
2. Will Greaves, "For Whom? From What? Canada's Arctic Policy and the Narrowing of Human Security," *International Journal*, Vol. 67, No. 1 (2011), p. 220.
3. Government of Canada, "Canada's Arctic Foreign Policy," no date; Government of Canada, "Canada's Arctic and Northern Policy Framework," 2019; and, for example, Nicholas Dunning, "Sovereignty and Human Security at Canadian Forces Station Alert," Royal Roads University, 2016.
4. See, for example, Greaves, "For Whom? From What?" p. 220.
5. *Ibid*.
6. Government of Canada, *Strong Secure Engaged: Canada's Defence Policy*, Ottawa, 2017, pp. 14, 17, 34-35, 57, 82.
7. *Ibid*., p. 92.
8. *Ibid*., p. 86.
9. Royal Canadian Navy, *Royal Canadian Navy: Strategic Plan 2017-2022*, 2017, p. 7.
10. *Ibid*., p. 12.
11. Royal Canadian Navy, *Leadmark: The Navy's Strategy for 2020*, 2001, p. 12.
12. *Ibid*., p. 74.

## *Cyber Considerations for Maritime Operations in the Canadian Arctic*

Major Bruno Perron[1] and Kristen Csenkey

There have been calls for enhanced naval presence and a more permanent role in the Canadian Arctic. Emerging technologies, naval actors, commercial shipping and communities in the Arctic may be subject to increased risk of malicious foreign interference and increased cyber incidents. This is because the Arctic has become a site of increasing geostrategic importance. As more actors become involved in this region, it may become an area of growing contestation.




Credit: Royal Canadian Navy

*The Royal Canadian Navy's Digital Navy strategy and action plan were released in early 2020 as part of the overall Digital Navy Initiative.*

Current and future Department of National Defence (DND)/Canadian Armed Forces (CAF) maritime operations need to consider potential cyber threats as part of the evolving security environment and hybrid warfare in the Arctic. Although cyber threats can occur in any domain and region, increased activity and focus on the Arctic, may complicate the dynamics of operations. The maritime domain is dependent on interconnected technologies with significant vulnerabilities that, if exploited, could have the potential to affect these operations and their effectiveness. The threat may also be indirect whereby a cyber incident could cause environmental harm, trigger the need for Arctic search and rescue, or cause an economic or sovereignty standoff through malicious interference.

Canada's defence priorities and commitment to operations in the Arctic have varied since the Cold War. The investment in new technologies, equipment and operations for DND/CAF and specifically the Royal Canadian Navy (RCN), signals a renewed focus on Arctic defence strategy. The defence policy *Strong, Secure, Engaged* (*SSE*)

Credit: MCpl Manuela Berger, Canadian Armed Forces

*Second Officer Dan Rutherford (right) briefs members of HMCS **Ville de Québec** and USS **Thomas Hudner** on the bridge of MV **Asterix** during **Operation Nanook 20** on 20 August 2020. One of the ship's integrated navigation and bridge system consoles can be seen in the foreground.*

released in 2017 characterizes the Arctic as the crossroads of emerging geopolitical issues where Canada must pursue long-term engagement to enhance capabilities and capacity in the region.[2] This engagement has materialized as the acquisition of new technologies and equipment, including Arctic and Offshore Patrol Ships (AOPS) for the RCN. The *Royal Canadian Navy Strategic Plan 2017-2022* echoes *SSE* by outlining plans for the RCN's increased role in the Arctic through the acquisition of equipment and the coordination of operations.[3] In addition, it recognizes the increasing role that the cyber domain will play in current and future postures.

Cyber and maritime operations are interconnected. *Digital Navy: A Strategy to Enable Canada's Naval Team for the Digital Age*[4] and *Digital Navy: Action Plan* highlight the importance of this interconnection by showing how the RCN plans to modernize with a focus on the use and integration of new technologies. The *Digital Navy* envisions the future RCN as a digitally connected and efficient force, able to engage in the digital domain.

This focus on enhancing capabilities for future warfighting is not without risks, and these risks exist in places we would not expect – like the Arctic. As such, there need to be cyber considerations that go beyond updating technologies and recognize the cyber threats that can affect naval operations and the maritime environment. The Arctic is an area where Canada and the United States, Russia and China seek to expand their interests. Cyber vulnerabilities – which may have been unthinkable in the past – come with this new activity. This is because warfare of the future will utilize the interconnectedness of technologies, tactics and actors through multiple domains.

### *Maritime Operations and Cyber Vulnerabilities*

The emerging threats to naval operations in the Arctic can be largely divided into three categories of cyber vulnerabilities. Let us discuss them in turn.

The first vulnerability is onboard the ships themselves. The significant material investment in the RCN and Canadian Coast Guard (CCG) that is occurring via the National Shipbuilding Strategy will usher in a new era of maritime operations in the Canadian Arctic. Modern ships, including the AOPS which will enter service with the RCN and CCG in the next few years, are highly networked platforms. Their daily operation requires a combination of information technology (IT) and operational technology (OT). IT is related to the daily use of computers, including those used at sea to communicate, perform logistics, manage human resources, and operate the electronic chart display and information system. Ship OT solutions have strong similarities to industrial control systems and supervisory control and data acquisition, such as those used in the energy sector. These network-dependent ships present a sizable attack surface, meaning that a determined malicious cyber actor has multiple potential vulnerabilities to exploit.

Second, ships, especially in the Arctic, depend on space-based platforms which also have a wide range of potential cyber vulnerabilities. Naval assets and shipping alike depend on satellites for communications and navigation using tools like Global Positioning System (GPS) and the Automatic Identification System (AIS) for collision

avoidance. Operations in the Arctic also depend on satellites for ice monitoring. The CCG and RCN surveillance mandate is performed by ships and aircraft, aided in their activities by satellites such as the RADARSAT family of Canadian-owned platforms.

And, third, northern communities could also be targeted by disinformation campaigns aiming to sow discord with government programming. This asymmetric threat has proven effective at this as well as targeting contentious issue areas in society. A few of these exist in the Canadian North, for example Indigenous, environmental and economic issues that could be exploited.

These three sets of vulnerabilities could directly affect naval operations, but also other actors in the maritime environment including commercial shipping. There is potential for an event that requires a whole-of-government response to address environmental or search-and-rescue issues that result from a cyber incident, which would be highly complex in the Arctic environment. The Canadian Arctic also has a growing natural resource exploitation sector, and considerable number of civil aviation routes, both of which could be victims of a cyber incident that would likely require RCN and CCG response.

An actor targeting entities in the Canadian Arctic could exploit a cyber vulnerability for financial gain, to support foreign influence or cause navigation incidents with severe environmental implications. All of these incidents would require a whole-of-government response, including operations by the RCN and CCG.

The main geopolitical threats in the region come from states like China and Russia. China has joined the Arctic Council as an observer, and claims to be a 'near Arctic' power. While China's objectives in the region are yet to be fully defined, the new MV *Xue Long 2* polar icebreaker and an ambition to create a 'Polar Silk Road' demonstrate definite ambition in the North. Russia's plans are more clear, with recent demonstration of its capabilities for interference launched against Denmark in the Faroe Islands and Greenland. Russia has started a campaign that aims to erode the cohesion between the two Arctic communities and Copenhagen.

One of the more prominent cyber attacks happened during the summer of 2017 and cost the Danish Shipping conglomerate Maersk between $250-300 million USD.[5] The problems at Maersk were caused by NotPetya, a malware that is believed to have propagated from an attack on Ukraine's electrical grid, widely attributed to Russia.[6] The effect on the maritime industry was catastrophic for several days, but ultimately incidental. This example focuses on financial harm, but emerging incidents of lesser scale may prove more alarming to Arctic and maritime security analysts. There is a growing number of reported spoofing and jamming activities against GPS and other Global Navigation Satellite Systems near Russian and Chinese spheres of influence.[7]

The International Maritime Organization (IMO), a UN body, has tried to enact international regulations to manage cyber risk, without much success thus far. Even the IMO is not immune from cyber threats, in fact its website and intranet were disabled by a sophisticated cyber attack in the fall of 2020.[8] There is potential for cyber incidents involving fake weather reports or spoofing navigation aids that could lead to destructive or at least disruptive collisions.

### *Looking Forward and Taking Action on Cyber*

Although the movie "WarGames" starring Matthew Broderick came out in 1983, the true potential of threats in cyber space is relatively nascent. The RCN needs to prepare responses to cyber incidents in the Arctic. Although the *Digital Navy* strategy seeks to invest in the integration of technologies with the goal of increased operational effectiveness, these cyber considerations go beyond technology updates. Cyber vulnerabilities may become pronounced in the Arctic region where the geographic isolation and severe climate complicate the most routine operations. A cyber incident could quickly devolve into an environmental or safety disaster requiring an RCN and CCG response. It's also a region that could experience an increase in malicious misinformation and disinformation. The RCN and CCG must consider these threats in strategy and procurement planning. Operational success rests on many variables – and cyber considerations must be one such focus – as part of a truly pan-domain approach to operations in the Canadian Arctic. CNR

**Notes**

1. The views expressed in this document are Major Perron's alone and do not represent the Department of National Defence or the Canadian Armed Forces.
2. Department of National Defence (DND), *Strong, Secure, Engaged: Canada's Defence Policy*. 2017.
3. DND, *Royal Canadian Navy Strategic Plan 2017-2022*, 2017.
4. DND, *Digital Navy: A Strategy to Enable Canada's Naval Team for the Digital Age*, 2020, available at http://www.navy-marine.forces.gc.ca/assets/NAVY_Internet/docs/en/innovation/rcn-digital-navy-initiative_v2.pdf.
5. Rae Ritchie, "Maersk: Springing Back from Catastrophic Cyber-attack," I - Global Intelligence for Digital Leaders, August 2019.
6. Andy Greenberg, "The Untold Story of NotPetya, the Most Devastating Cyber-attack in History," *Wired Magazine*, 22 August 2018.
7. See "Above Us Only Stars: Exposing GPS Spoofing in Russia and Syria," C4ADS, November 2018, available at https://www.c4reports.org/aboveusonlystars; and Joseph Trevithick, "New Type of GPS Spoofing Attack in China Creates 'Crop Circles' of False Location Data," *The Drive*, 18 November 2019, available at https://www.thedrive.com/the-war-zone/31092/new-type-of-gps-spoofing-attack-in-china-creates-crop-circles-of-false-location-data.
8. "UN Shipping Agency Says Cyber Attack Disables Website," Reuters, 1 October 2020.

# *Dollars and Sense:* Canada's Surface Combatant Costs

**Dave Perry**

In February 2020 the Parliamentary Budget Officer (PBO) will release an updated costing of the navy's Canadian Surface Combatant (CSC) project. Currently budgeted at between $56-60 billion, the PBO is likely to report that substantially more money is needed to deliver the CSCs. That report could be a seminal moment in the project's life, and that of the Royal Canadian Navy. In no small measure the future of Canada's navy is intrinsically linked to the CSC project, as at present it represents the entirety of Canada's government approved and funded naval combat fleet.

There is significant reason to be wary about a report from PBO finding a significant gap between how much money the Department of National Defence (DND) believes the project will require for successful completion and its own estimate. As well, the report will be released to a minority Parliament during a worldwide economic crisis which is placing severe strains on Canadian federal finances. If that situation sounds familiar, it is because those same conditions were present when the PBO reported in 2011 that much more money than DND was reporting publicly at the time would be needed to acquire the F35 fighter jet. That report initiated a sequence of events that derailed the project, and a decade later, Canada still has not bought a new fighter jet, although bids have been received under the revamped competition. If the PBO finds more money is needed for the CSC project, that could spell trouble.

As it stands, the last PBO costing from 2019 estimated the budget should be closer to $70 billion than to $56-60 billion. Two key things have changed since then that will likely push its estimate higher. First, there are rumblings that the project is facing significant delays, placing delivery of a first ship in the 2020s out of reach. In its last effort, the PBO pegged the cost of an additional year of delay at over $2 billion.[1]

It is unclear where exactly the project stands as the government has said virtually nothing about the progress of the project since February 2019 when Lockheed Martin Canada was confirmed as Canada's winning bidder and the project entered into a critical period of detailed design work. Canadian officials and Irving Shipbuilding, the project's prime contractor, have been reviewing the detailed bid to understand it fully, make changes and translate the bid proposal into the actual ship that will be built in Halifax. That effort is complicated, time consuming and arguably more difficult than the phases of the project that came before it, and in those earlier phases the project consistently missed one milestone after another. It is moving forward, but there is no evidence suggesting that the pace of the project has improved as the work became more difficult and that is without trying to account for any COVID-related impacts. Using the PBO's last report, a delay of just a couple of years on its own could increase costs by about $5 billion.

The second key change between the PBO's last report and the present time relates to the actual ship itself and what Canada intends to build. When the PBO last costed the project, its analysis was based on the Royal Navy's Type 26 frigate, which had been identified at the time as the ship design upon which the winning submission was based. But the Type 26 was just the starting point for that bid, as Lockheed proposed modifying that ship design extensively to ensure it meets the navy's requirements and provides the economic benefit required by the government. Since submitting that bid in October 2018, the requirements have gone through a 'reconciliation' process that was either finished a long time ago, just finished recently, or is still ongoing, depending on whom you ask. While the parameters of this process have been fuzzy, it seems to have resulted in significant additional combat capability being added to Canada's future warships. As one assessment put it, the ship will be "brimming with missiles,"[2] including modern anti-air, area-air and anti-surface weapons

*Credit: SI Zach Barr, Air Task Force Romania*

*A CF-188 Hornet at Mihail Kogălniceanu Air Base, Romania, on 27 October 2020 as part of Canada's contribution to NATO operations in Europe. Nine years after the Parliamentary Budget Office report on the rising costs of the Hornet replacement, the Future Fighter Capability program remains in its competition stage.*

Credit: Royal Canadian Navy

# CANADIAN SURFACE COMBATANT

## The right ship for the RCN. The right ship for Canada.

### Surveillance & Weapon Sensors
- Solid State 3D Active Electronically Scanned Array (AESA) Radar – *LMC SPY-7*
- Solid State AESA Target Illuminator – *MDA*
- Navigation Radars – *X & S Band*
- Electro-Optical and Infrared Systems

### Electronic Warfare & Countermeasures Suite
- Radar/Radio ESM Frequency Identification
- Laser Warning and Countermeasures System
- Radio Frequency and Electronic Jammers
- Electronic Decoy System

### Command & Control
- Combat Management System – *LMC CMS 330 with AEGIS*
- USN Cooperative Engagement Capability – *Sensor Netting*
- Integrated Cyber Defence System
- Integrated Bridge and Navigation System – *OSI*
- Internal and External Communication Suite – *L3 Harris*

### Weapons
- Missile Vertical Launch System 32 Cells – *LMC MK 41*
- Area Air Defence Missiles – *Raytheon Standard Missile 2*
- Point Defence Missiles – *Raytheon Evolved Sea Sparrow*
- Naval Fires Support – *Raytheon Tomahawk*
- Main Gun System – *127mm*

### Aviation Facilities
- 1 x CH-148 Cyclone Helicopter
- Space for embarking Remotely Piloted Systems
- Helo Hauldown and Traverse System – *Indal Technologies Inc.*

### Weapons
- Lightweight Torpedoes MK54 & Twin Launch Tubes
- Close-In Air Defence System – *MBDA Sea Ceptor*
- Surface-to-Surface Anti-Ship Missile – *Kongsberg Naval Strike Missile*
- 2 x Stabilized Rapid Fire 30mm Naval Gun System – *BAE*

### Reconfigurable Mission & Boat Bays
- 1 x Rescue Boat – *9 metres*
- 2 x Multi-Role Boats – *9-12 metres*
- Mission Bay Handling System – *Rolls Royce*
- Modular Mission Support Capacity – *Sea Container, Vehicles, Boats*

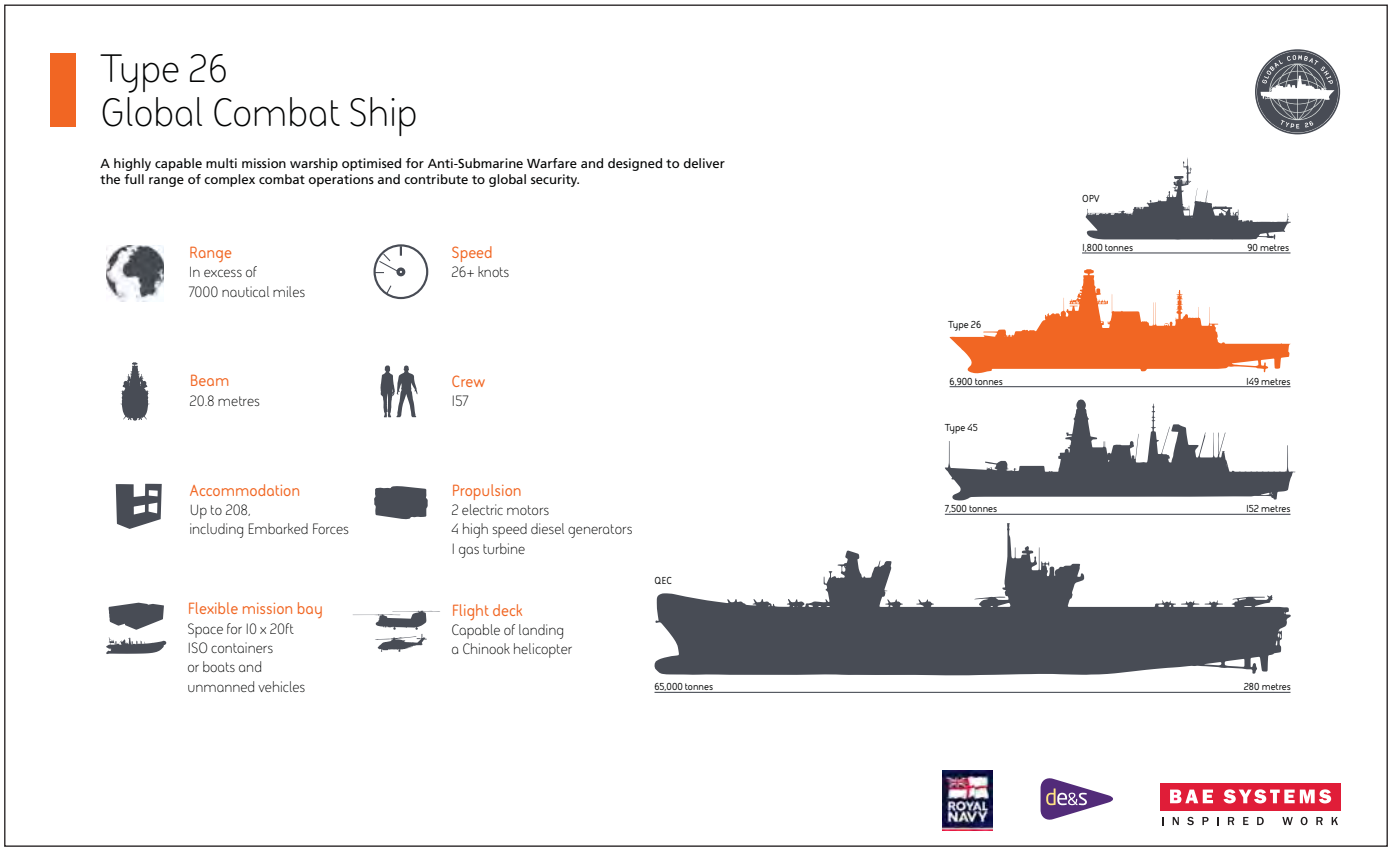
### Propulsion & Power Generation
- Combined Diesel-Electric or Gas Propulsion System (CODLOG)
- 2 x Electric Motors – *GE*
- 1 x Gas Turbine – *Rolls Royce MT 30*
- 4 x Diesel Generators – *Rolls Royce MTU*
- Integrated Platform Management System – *L3 Harris*

### Integrated Underwater Warfare System
- Towed Low Frequency Active & Passive Sonar – *Ultra Electronics*
- Hull-Mounted Sonar – *Ultra Electronics Sonar S2150*
- Towed Torpedo Countermeasures – *Ultra Electronics SEA SENTOR S21700*
- Sonobuoy Processing System – *General Dynamics*
- Expendable Acoustic Countermeasures

### Specifications:
Length: 151.4 metres
Beam: 20.75 metres
Speed: 27 knots
Displacement: 7800 tonnes
Navigational Draught: ~8m
Range: 7000 nautical miles
Class: 15 ships

### Habitability:
Accommodations: ~204
Medical Facilities
Dedicated Gym/Fitness Facilities
Shipboard Wi-Fi

Royal Canadian Navy Public Affairs –November 2020




*Credit: Ministry of Defence/Crown Copyright 2017*

*A Royal Navy infographic shows the baseline Type 26 within the fleet architecture of the Royal Navy. Eight Type 26s will be built in addition to five cheaper Type 31 frigates. Unlike the RCN, the RN has dedicated anti-air warfare destroyers in the form of the Type 45, and thus its Type 26 lacks the long-range air defence capabilities planned for the CSC.*

◂ OPPOSITE PAGE *This infographic for the Canadian Surface Combatant was released by the navy in November 2020. It highlights some of the major characteristics including sensors, weapons fit and dimensions of the CSC, which differ considerably from the baseline Type 26 design.*

Canadian ships have previously carried as well as the new-to-Canada Tomahawk land-attack missile and the land-attack function it will provide.

The net result, as material recently released by the RCN makes clear, is that the CSC as currently envisioned is a very different ship than the Type 26. It is both heavier and longer. And while the hull and related systems are largely the same, virtually the entire combat system is different. Costing out the differences between the major components of the combat system would presumably be a key feature of the PBO's report, including the radar, major weapons systems, combat management system, and the Cooperative Engagement Capability sensor network. Similarly, the PBO might try and assess the implications of Canada acquiring a ship with a purpose-built combat system and the extensive design and systems integration work that will be required to make it combat effective, including the impact on schedule.

As we await the PBO's report, it is worth remembering that the organization has developed a solid track record of estimating the costs of ships built under the National Shipbuilding Strategy. If it finds that significantly more money is needed to deliver this project, that may be a good sign that Canada should revisit the governance and management of this project to ensure it is being managed well. The project's schedule keeps drifting and some of the most difficult work lies ahead. Ensuring we have project management and governance that can effectively manage an extraordinarily complicated developmental project is the best way to keep the project's costs down and deliver the navy Canada needs.

While the federal government has been acting like money is no object since the COVID pandemic started, that sentiment is unlikely to last forever, and this project could see some orders being placed more than a decade from now. World-class management of this project is imperative to deliver both world-class ships and best value for Canadian taxpayer dollars. CNR

**Notes**

1. Office of the Parliamentary Budget Officer, "The Cost of Canada's Surface Combatants: 2019 Update," available at https://www.pbo-dpb.gc.ca/web/default/files/Documents/Reports/2019/Canada-Surface-Combatants-update/CSC_Update_2019_Report_E.pdf.
2. Joseph Trevithick, "Canada's New Frigate will be Brimming with Missiles," *The Drive*, 13 November 2020, available at https://www.thedrive.com/the-war-zone/37506/canadas-new-frigate-will-be-brimming-with-missiles

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# *Warship Developments:* Potpourri

**Doug Thomas**

## *Littoral Combat Ships*

The Littoral Combat Ship (LCS) is the result of an interesting US Navy concept to develop exceptionally fast warships to operate in coastal (littoral) regions of interest. The program was initiated in 2001 by Chief of Naval Operations Admiral Vern Clark to build relatively inexpensive, highly automated vessels with small crews, which thus could be built in large numbers – 55 were intended. The LCS was to be a very flexible vessel operationally, designed to be fitted quickly with one of three mission modules: mine countermeasures; anti-submarine warfare; and surface warfare. As well, the ships would be able to take on a team of 30 to 40 trained people to operate the components of the embarked module. The devil has been in the details, with problems in developing the modules as acquisition of some components were cancelled and modular costs skyrocketed. The number of modules built was totally inadequate to provide the intended flexibility, and frequently portions of equipment or weapons have been embarked for specific missions rather than a non-existent or unavailable complete modular package.

There are two variants, the *Freedom*-class with a mono-hull and the *Independence*-class with a trimaran hull configuration and a large flight deck. Unfortunately, there have been many problems. Construction costs mushroomed, innovative manning plans such as rotating three crews every four months between two ships have proven unsuccessful, and the *Freedom*-class variant has an unreliable propulsion system. It has two low-speed diesel engines capable of about 12 knots for routine operations, and two very powerful gas turbines which boost maximum speed to over 40 knots. In order to achieve such speed, the power of the gas turbines and diesels must be combined through a complex device known as the combining gear. To date there have been numerous mechanical and personnel failures resulting in embarrassing breakdowns. It is one thing to have such failures in peacetime, quite another if you are being shot at!

A number of solutions have been tried to make the LCS more effective, including having several of each type work together and providing the resultant task group with a support ship, such as an Expeditionary Sea Base, to provide maintenance and repair capability when deployed away from home ports. Other corrective actions are underway, and program numbers are being reduced. The first four LCSs (two of each configuration) are being paid off in March 2021 at the youthful ages of nine to 12 years. They are test vessels built to trial unique equipment and operating concepts, and will likely be scrapped as uneconomical to upgrade for operational use. A new class of much more capable frigates, FFG(X), is being acquired to meet fleet requirements for surface warships smaller than destroyers.

## *The Canadian Surface Combatant*

The Parliamentary Budget Officer (PBO) was ordered to investigate two alternatives to the Type 26 frigate design for the Canadian Surface Combatant (CSC) and provide a report by 22 October 2020. The PBO has missed that deadline. The alternative designs are the British Type 31 and the Italian version of the FREMM – a modern


*Credit: Danette Baso Silvers, US Navy*

*The* ***Freedom****-variant Littoral Combat Ship USS* ***Detroit*** *LCS 7 arrives at Naval Air Station Key West on 5 June 2020.* ***Detroit*** *suffered from propulsion issues in October that forced it to return home from a deployment to the Caribbean and South America.*

Credit: Mass Communication Specialist Seaman Riley McDowell, US Navy

*USS **Gerald R. Ford** CVN 78, first of its class, conducts flight operations with Carrier Air Wing 8 and Destroyer Squadron 2 on 13 November 2020 during its first integrated carrier strike operations.*

Franco-Italian frigate design being procured by those navies. As readers may remember from my last column, the Italian FREMM variant also will be the basis for up to 20 USN frigates required due to the operational shortcomings of the LCS. Recent news from the USN's FFG(X) program indicates that costs will be higher than initially predicted. Perhaps the Type 26 CSC is not such a bad deal after all?

### *USN Ford-Class Aircraft Carriers*

The most expensive warship ever built is USS *Gerald R. Ford*, the first new American aircraft carrier design in 41 years. The carrier cost some $13 billion (US), construction commenced in 2005, commissioning occurred in 2017, and the first operational deployment is anticipated in 2022. Part of the reason that the ship is so expensive is that it incorporates many new technologies for the class such as: Electromagnetic Aircraft Launch System (EMALS) replacing steam catapults; Advanced Arresting Gear (AAG), a new arresting system to recover aircraft; new weapons elevators; volume search and multi-function radar; and a new nuclear propulsion system. The aim is to produce a class of aircraft carriers capable of launching 25% more aircraft sorties per day with a crew 25% smaller than the *Nimitz*-class carriers currently in service. The reduced crew is anticipated to save at least $4 billion over the expected 50-year lifespan of USS *Gerald Ford*.

EMALS and AAG have many benefits over the systems fitted in the *Nimitz* carriers, including inflicting less stress on the structure of aircraft during launch and recovery, thus extending their service life. EMALS and AAG can also be fine-tuned to match the launch/recovery requirements of different types of aircraft.

There have many equipment issues during sea trials, but this is to be expected with such a revolutionary vessel. These issues will be resolved and solutions applied to future ships of the class with four additional *Ford*-class carriers ordered to date: USS *John F. Kennedy*, USS *Enterprise*, USS *Doris Miller* and another on order but not yet named.

### *Chinese Aircraft Carrier Program*

Since the 1970s, China has had ambitions for the People's Liberation Army Navy (PLAN) to operate aircraft carriers, and since 1985 has acquired a number of retired aircraft carriers for study namely the Australian HMAS *Melbourne*, and the ex-Soviet carriers *Minsk, Kiev* and the incomplete hulk *Varyag*, sister ship to the Russian Navy's *Kuznetsov*. *Varyag* later underwent a complete rebuild and was renamed *Liaoning*, China's first operational aircraft carrier. China now has a second similar aircraft carrier, *Shandong*. This means that the PLAN has two combat-ready 60,000-ton aircraft carriers, *Liaoning* and *Shandong,* which embark air groups of about 25 V/STOL jet fighters – a small number of limited capabilities.

A third carrier designated 003, believed to be the lead ship of a new class, is under construction and projected to become operational in 2023. The third carrier is considerably larger than the first two at some 85,000 tons and fitted with catapults – likely steam catapults although an EMALS would permit the operation of much more capable aircraft. Future carriers may have nuclear propulsion if China wishes to compete with US Navy aircraft carriers. Nuclear propulsion would greatly extend the radius of action of future Chinese carriers, and could generate the vast quantities of electrical power needed for such technologies as EMALS. It is projected that China may possess five or six aircraft carriers by the 2030s, second only to the number in the US fleet. CNR

# Book Reviews

*China's Maritime Gray Zone Operations*, edited by Andrew S. Erickson and Ryan D. Martinson, Annapolis, MD: Naval Institute Press, 2019, 352 pages (hardcover), ISBN 978-1-59114-693-3

Reviewed by Colonel (Ret'd) Brian K. Wentzell

This book is important for people interested in maritime operations and China. The 21 contributors to the book have studied and written about the maritime strategy of the People's Republic of China as it relates to both the East China Sea and South China Sea. The articles in the book discuss not only the strategy, but also the apparent aims and actual means for the implementation of the strategy. The contributors also analyse the responses of the states most seriously affected by the actions of China, namely, Japan, Taiwan, the Philippines, Vietnam and Malaysia. The outcomes are not comforting to those who believe in the freedom of the seas.

The contributors examine, in some depth, the actions of the People's Liberation Army (Navy) (PLAN), the China Coast Guard (CCG), and the People's Armed Forces Maritime Militia (PAFMM) in the seas. These services are colloquially referred to as the gray, white and blue hulls, respectively. The authors focus in particular on China's 'paranaval' forces – the white hulls and blue hulls.

The actions of these organizations reveal important aspects of the current efforts of China to secure maritime areas and resources to the exclusion of other countries and peoples. The three services use 'non-kinetic' means to thwart the efforts of other states and their citizens to harvest fish stocks, petroleum and other natural resources. They are also used to assist with construction and the improvement of infrastructure on islands, reefs and rock outcroppings in both the South China Sea and the East China Sea. The navy, coast guard and maritime militia use presence and intimidation to achieve their purposes.

Non-kinetic actions include anything short of the use of naval guns, missiles and personal weapons. For example, they include deliberate collisions through the actions of Chinese ships, the use of white light at night, the creation of noise, interference with communications, and use of water cannons. These actions are intended to dissuade native fishermen and others from pursuing their rightful work. In some cases, the Chinese have physically occupied rocky outcroppings and developed them into military installations. Such actions are undertaken under the guise that China has historic rights to occupy what it claims to be traditional Chinese territories, notwithstanding international law and contradicting historical facts.

These actions are discussed in this book. And from this, the question that arises from the Chinese maritime actions is simple. What country, if any, will stand up to China? Will pressures from or actions of the United States, Japan and Vietnam, the strongest defenders of the freedom of these seas, curtail its actions? Will internal actors and pressures develop to minimize or reverse the apparent successes of China's current political leadership? These are important questions that cannot be answered today but will preoccupy politicians, military officials, business leaders and citizens of the many countries bordering the Pacific Ocean and beyond.

This book is very highly recommended as it reveals an important part of Chinese historic and current goals, attempts to explain the forces behind China's maritime expansion into the 'gray' zone between war and peace, and the impact upon current events. CNR

# 2021 Canadian Naval Memorial Trust
# Essay Competition

*Canadian Naval Review* will be holding its annual essay competition again in 2021. There will be a prize of $1,000 for the best essay, provided by the **Canadian Naval Memorial Trust**. The winning essay will be published in *CNR*. (Other non-winning essays will also be considered for publication, subject to editorial review.)

Essays submitted to the contest should relate to the following topics:

- Canadian maritime security;
- Canadian naval policy;
- Canadian naval issues;
- Canadian naval operations;
- History/historical operations of the Canadian Navy;
- Global maritime issues (such as piracy, smuggling, fishing, environment);
- Canadian oceans policy and issues;
- Arctic maritime issues;
- Maritime transport and shipping.

If you have any questions about a particular topic, contact **cnrcoord@icloud.com**.

### *Contest Guidelines and Judging*

- Submissions for the 2021 *CNR* essay competition must be received at cnrcoord@icloud.com by Thursday, **30 September 2021**.
- Submissions are not to exceed 3,000 words (excluding references). Longer submissions will be penalized in the adjudication process.
- Submissions cannot have been published elsewhere.
- All submissions must be in electronic format and any accompanying photographs, images, or other graphics and tables must also be included as a separate file.

The essays will be assessed by a panel of judges on the basis of a number of criteria including readability, breadth, importance, accessibility and relevance. The decision of the judges is final. All authors will be notified of the judges' decision within two months of the submission deadline.


RCN patrol ships new and old: HMCS *Harry DeWolf* sails in front of HMCS *Summerside* outside Halifax on 15 October 2020.

*Credit: Corporal David Veldman, Canadian Armed Forces*