Naval Association of Canada
Discussion Paper

Submarine Procurement

Widening the Aperture of Options

Vice-Admiral RCN (Retd) Robert Davidson CMM MSC CD

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

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

The Department of National Defence (DND) will need to convince Cabinet that this capability is

worth the political and economic capital. A funding envelope and spending authority will be essential and an early Memorandum to Cabinet (MC) is, therefore, a logical first step. Such an MC will need to address:

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

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

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

The recent Australia/UK/USA (AUKUS) strategic agreement may have changed the environment. It may open the potential for a nuclear propulsion option without necessarily creating a nuclear supply chain in Canada, the cost of which doomed our last exploration of this option in the late 1980s. While nuclear propulsion has clear advantages, it is a stretch to believe that any Canadian government will find nuclear propulsion politically saleable in the current environment, particularly for Arctic applications. Still, the government should make this call and so it should not be excluded from consideration.

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

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

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

Bigger hulls use more steel and are therefore more expensive; this could limit the number of hulls that can be afforded. Bigger submarines also have limited shallow water access, except when equipped with underwater remote vehicles. Submarine vulnerability and detectability increase with size. Conventional submarines, even with modern batteries and AIP systems, are limited in their speed and endurance – compared to their nuclear cousins. Quite simply, without nuclear propulsion, the power-to-weight ratio favours smaller submarines. Bigger may mean more range but it may not produce a dramatic increase in AIP endurance over some of the smaller submarines already in service. Fixing the size requirement at 3,500 tons or more, as recommended by some analysts, starts us down a limiting and costly path. Smaller submarines should be included in the analysis and options. A smaller hull size opens the door for more submarine yards and builders to compete while smaller less costly hulls may mean more submarines are affordable.

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

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

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

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

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

- The HLS transports the submarine to the operations area eliminating the transit/range problem that favours a larger submarine
- The HLS can be built in Canada, creating a valuable industrial offset.
- With no submarine sea days lost in transit, more operational days are available in any deployment.
- The HLS can provide repair facilities, docking, refuelling (including AIP), re-arming or weapon change-outs, re-storing, and submarine crew accommodations closer to the operating area.
- Crews can be flown to join the deployed submarine/HLS.
- Some repairs that previously forced an early return transit to home port can be addressed locally.
- Special Operations capabilities and personnel can be housed in the HLS
- The HLS has utility for humanitarian lift to northern communities and areas affected by natural disasters.
- An HLS could be operated by industry.

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

Notes

[1] A modern Navy needs experience across the spectrum of maritime operations to be credible to lead international operations. Submarines also offer access to the club of submarine operating allies within which intelligence and movement information is exchanged. A submarine with a heavy weight torpedo and/or anti-ship missiles is a strategic capability than can deny area access to an adversary.
[2] While may carry less weight nationally, it will be key for our NATO and other allies
[3] AIP is any technology that provides for the generation of power without access to atmospheric oxygen. Batteries, closed cycle and Stirling engines and fuel cells. These systems may require stored hydrogen and/or oxygen or a reformer that can produce hydrogen from another fuel source. AIP enables a submarine to remain submerged for extended periods without accessing the atmosphere to run large diesel engines.
[4] Canada's Arctic currently contains 23 polynyas or open-water areas surrounded by sea ice. These are created by winds, currents and upwelling warmer water. (Source: Canadian Geographic, Status and trends in Arctic Biodiversity)

Vice-Admiral Robert (Bob) Davidson CMM MSC CD, served in the RCN for 39 years seeing service in submarines and ships. He commanded the submarine HMCS *Ojibwa* and the Halifax-class frigate HMCS *St John's,* Maritime Operations Group 4, Canadian Fleet Atlantic, and CTF 150. He served as the Director of the Strategic Joint Staff and finished his career as Canada's Military Representative to NATO Headquarters in Brussels. Bob is a graduate of Carleton University (BSc), the New York Institute of Technology (MBA), Canadian Forces College (CFCSC and NSS) and the Advanced Leadership Program of the Canadian School of Public Service.