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CANADA'S NEED FOR A NUCLEAR SUBMARINE CAPABILITY TO ENSURE ARCTIC SOVEREIGNTY AND SECURITY

Lieutenant-Colonel John Hlibchuk

JCSP 44

Exercise *Solo Flight*

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INTRODUCTION

Not one of Canada's submarines participated in ICEX 2018, a joint US, British and Canadian Arctic exercise designed to test the under-ice capabilities of each of our submarines.[1] Our subs, HMCS *Windsor*, *Victoria*, *Chicoutimi* and *Corner Brook*, are not designed for those kinds of under-ice uses.

As Stephen Harper said in July 2007, with respect to defending Arctic sovereignty, we "either use it or lose it."[2] Without the ability to patrol and protect its Arctic sovereignty, Canada relies on its allies, in particular the U.S. Navy (USN), to help enforce it.[3]

But the days of such a cozy and dependent relationship may be coming to an end, just as it will be evermore important to safeguard our sovereignty and security. Russia is increasingly assertive in the Arctic, while rising nations, most importantly China, are showing increasing designs on it, both for its resources and for its strategic and commercial routes. At the same time, the US is showing signs of withdrawing from the international stage, and becoming increasingly weary of shouldering the defence responsibilities of others.[4]

In this context Canada must be ready to assert its Arctic sovereignty, and ensure its security. Canada can look to the example of another middle-power seeking influence over its

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[1] Kaila Jefferd-Moore, "Canadian Submarines not part of international Arctic under –ice exercise," *CBC News,* 11 Jun 2018: 4, last modified [or accessed] 9 March 2019, https://www.cbc.ca/news/canada/north/canadian-submarines-not-part-of-international-arctic-under-ice-exercise-1.4699208.
[2] Stephen Harper, speech, CFB Esquimalt, British Columbia, 9 July 2007.
[3] Kaila Jefferd-Moore, "Canadian Submarines not part of international Arctic under –ice exercise"…, 4.
[4] John J. Mearsheimer and Stephen M. Walt, "The Case for Offshore Balancing: A Superior U.S. Grand Strategy," *Foreign Affairs* 95, no. 4 (July/August 2016): 70.

offshore waters and resources through the acquisition of a nuclear-propelled submarine (SSN): Brazil. Brazil has increased its influence over its offshore waters and resources through the exercise of soft power, while slowly building up its military capacity for the future, including a nuclear submarine program with the help of France.

This essay will examine the current changing security context in the Arctic, with a particular focus on Chinese and Russian encroachment juxtaposed against American isolationism, and argue, based upon a comparison of the situation faced by Brazil, that in order to secure our Arctic sovereignty in this harsh, austere and ever-changing environment, Canada should build 6 SSNs supported by a foreign shipbuilder.

1 – CURRENT CHANGING SECURITY CONTEXT

Opening of the Northwest Passage

Canada has an immense ocean estate, covering approximately 7.1 M km^2, with the longest coastline in the world measuring 243,042 km, the 5th largest Economic Exclusion Zone at 5,543,913 km^2 and the second largest continental shelf.[5]

The Arctic Ocean is the largest,[6] and Canada's best known sovereignty issue remains control over maritime traffic in the Northwest Passage. We claim that these waters are internal, giving Canada the right to control entry and conditions upon same. The American and EU position is that these waters are part of an international straight.[7]

Climate change is opening up the Arctic as a commercially viable sea route between Europe and Asia for the first time in recorded history. Receding ice and improvements in extraction technology will likely make resource exploitation commercially viable.[8]

As this change happens, non-Arctic states wish to play an increased role in the region.[9] Chief among those competing for Arctic resources are Russia and China, and with expanding access for shipping and resource extraction in the Arctic, state military capabilities are expanding.

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[5] Department of National Defence, *LEADMARK 2050: Canada in a New Maritime World* (Ottawa: Director of Maritime Strategy, 2016), 1.
[6] *Ibid*., 1.
[7] Rob Huebert, "Submarines, Oil Tankers, and Icebreakers: Trying to Understand Canadian Arctic Sovereignty and Security," *International Journal* 66, (Autumn 2011): 812.
[8] Department of National Defence, *LEADMARK 2050…,* 10.
[9] Adam Lajeunesse, *Finding "Win-Win" China's Arctic Policy and What it Means for Canada* (Calgary: Canadian Global Affairs Institute, 2018), 2.

Russian Encroachment

Russian Capabilities, Motivations and Activities

Russian policies in the Arctic are guided by pragmatic interest in both competition for natural resources, and control of northern sea routes. [10] Russia demonstrates its military power in the Arctic primarily through strategic bomber flights, nuclear submarines, naval patrols and exercises. [11]

A substantial part of the Russian Navy is the Northern Fleet, the largest of Russia's 5 fleets. It is growing, increasingly active,[12] and includes most of Russia's SSNs which patrol under the Arctic ice.[13] The planting of a Russian flag on the ocean floor at the North Pole in 2007, coupled with the resumption of strategic bomber patrols in the high north in 2008 returned Russia to a robust Arctic presence.[14]

NATO has increased its attention upon Russia's ability to project force into the North Atlantic from its Arctic territory to challenge NATO's collective defence posture. Canada and its allies must deter and defend against such threats, including against sea lines of communication and maritime approaches to NATO territory. [15]

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[10] Lassi Heininen, Alexander Sergunin and Gleb Yarovski, *Russian Strategies in the Arctic: Avoiding a New Cold War,* (Moscow: Valdai Discussion Club, 2014): 4.
[11] *Ibid*., 79.
[12] Senate, Standing Senate Committee on National Security and Defence, *Reinvesting in the Canadian Armed Forces: A Plan for the Future* (Ottawa: Canada Communications Group, 2017), 29.
[13] Siemon T. Wiseman, *Military Capabilities in the Arctic: A New Cold War in the High North?* (Solna, Sweden: Stockholm International Peace Research Institute, 2016), 15.
[14] Lassi Heininen, Alexander Sergunin and Gleb Yarovski, *Russian Strategies in the Arctic: Avoiding a New Cold War…,* 4.
[15] Department of National Defence, *Strong Secure Engaged: Canada's Defence Policy* (Ottawa: DND Canada, 2017), 79.

The Effect of Ongoing Tensions in Ukraine

Russia's 2014 annexation of Crimea and ongoing tensions with NATO in Ukraine are creating military and strategic tensions which could spill over into the Arctic,[16] as evidenced by Canada boycotting the 2014 Arctic Council meeting in Moscow.[17]

Before the crisis, increased Russian Arctic activity was widely interpreted as legitimate state behaviour to monitor and secure its 7,000- kilometre-long border region and strategic assets, and to support civilian activities therein.[18]

After the crisis, increased Russian capability and activity in the Arctic has been reinterpreted as a sign of aggressive and threatening behaviour, and an illustration of Russia's intention to militarize and dominate the Arctic region.[19]

China's "Near-Arctic" Policy

On January 26, 2018 China issued its first white paper on Arctic Policy, declaring itself a "Near-Arctic State"[20] and a major stakeholder in the Arctic.[21] In that capacity, China vowed to actively participate in Arctic affairs.[22] Regarding climate change and the opening of the Arctic for commercial exploitation China noted:

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[16] Adam MacDonald, "The Militarization of the Arctic: Emerging Reality, Exaggeration, and Distraction," *Canadian Military Journal*, (Summer 2015): 24.
[17] *Ibid*., 25.
[18] Juha Käpylä and Harri Mikkol, "On Arctic Exceptionalism: Critical Reflections in the Light of the Arctic Sunrise Case and the Crisis in Ukraine," *Finnish Institute for International Affairs Working Paper 85* (April 2015): 12.
[19] *Ibid*.
[20] Xinhua, "Full text: China's Arctic Policy," *Xinhuanet*, 26 January 2018: 4, last modified [or accessed] 23 March 2019, http://www.xinhuanet.com/english/2018-01/26/c_136926498.htm.
[21] *Ibid*.
[22] Charlotte Gao, "China Issues its Arctic Policy," *The Diplomat* (26 January 2018): 1, https://thediplomat.com/2018/01/china-issues-its-arctic-policy.

> The Arctic boasts a unique natural environment and rich resources, with most of its sea area covered under thick ice for most of the year. The Arctic natural environment is now undergoing rapid changes. Over the past three decades, temperature has been rising continuously in the Arctic, resulting in diminishing sea ice in summer. Scientists predict that by the middle of this century or even earlier, there may be no ice in the Arctic Ocean for part of the year. On the one hand, melting ice in the Arctic has led to changes in the natural environment, or possibly can result in accelerated global warming, rising sea levels, increased extreme weather events, damaged biodiversity, and other global problems. On the other, with the ice melted, conditions for the development of the Arctic may be gradually changed, offering opportunities for the commercial use of sea routes and development of resources in the region. Commercial activities in the region will have considerable impact on global shipping, international trade and energy supply, bring about major social and economic changes, and exert important influence on the way of work and life of Arctic residents including the indigenous peoples. They may also pose a potential threat to the ecological environment of the Arctic. The international community faces the same threat and shares the same future in addressing global issues concerning the Arctic.[23]

China specifically mentioned the Arctic`s "abundant resources," [24] and expressed its desire to participate in the development of Arctic shipping routes; explore for and exploit oil, gas, mineral and other non-living resources;[25] and develop capacity in the Arctic through applied Arctic technology.[26]

In affirming this desire, China declared that states from outside the Arctic region do not have territorial rights but other rights:

> States from outside the Arctic region do not have territorial sovereignty in the Arctic, but they do have rights in respect of scientific research, navigation, overflight, fishing, laying of submarine cables and pipelines in the high seas and other relevant sea areas in the Arctic Ocean, and rights to resource exploration and exploitation in the Area, pursuant to treaties such as UNCLOS and general international law. In addition, Contracting Parties to the Spitsbergen Treaty enjoy

[23] Xinhua, "China's Arctic Policy"…, 2.
[24] *Ibid*., 10.
[25] *Ibid*., 11.
[26] *Ibid*., 6.

> the liberty of access and entry to certain areas of the Arctic, the right under conditions of equality and, in accordance with law, to the exercise and practice of scientific research, production and commercial activities such as hunting, fishing, and mining in these areas.[27]

Chinese Participation in the Development of Arctic Shipping Routes

Billions of dollars have flowed into oil and gas projects in Siberia and the Russian Arctic offshore, new shipping routes have been tested, and Chinese mining companies have acquired claims in Greenland and Canada.[28]

The sea lanes connecting these investments, supported by Chinese infrastructure, have been labelled the "Polar Silk Road," a maritime trade and shipping route that theoretically runs through the Northwest Passage and other circumpolar channels.[29]

The Rise of the Chinese Navy

China's rise as a naval power is guided by its desire to project power and obtain control, sometimes by brute force, over shipping lanes, fishing and resource rights; and economic zones.[30]

China is expanding its maritime influence outside Asia and opened its first naval base abroad in Djibouti last year.[31] On April 23, 2019 while celebrating the 70th anniversary of the Chinese Navy, President Xi declared that "a peace loving China yearned to work with foreign

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[27] *Ibid*., 2.
[28] Adam Lajeunesse, *Finding "Win-Win" China's Arctic Policy and What it Means for Canada*…, 1.
[29] *Ibid*.
[30] Senate, Standing Senate Committee on National Security and Defence, *Reinvesting in the Canadian Armed Forces: A Plan for the Future…*25.
[31] "China`s maritime ambitions are becoming more evident," *The Economist*, 23 April 2019: 4, last modified [or accessed] 23 April 2019, https://www.economist.com/china/2019/04/23/chinas-maritime-ambitions-are-becoming-more-evident?cid1=cust/dailypicks/n/bl/n/20190423n/owned/n/n/dailypicks/n/n/NA/231321/n.

navies to secure international sea lanes and safeguard the ocean`s riches."[32] He then boarded a new nuclear-powered ballistic missile submarine.

No longer a brown or green-water Navy, China now has over 300 ships of which more than 78 are submarines.[33]

American Isolationism

Historically we rely too much on the Americans for our security. The US can no longer be relied upon to drive world economic growth and single-handedly underwrite international security.[34] The Americans are increasingly engaging in offshore balancing and push others to spend more on their own defence. Large numbers of Americans now believe that the US should deal with its own problems and let others deal with their own.[35]

Today three areas matter to the US: Europe, Northeast Asia and the Persian Gulf. [36] While the Americans cannot "opt-out"[37] of defending Canada generally, they could allow others to impede upon our Arctic sovereignty when it is not necessary for their own interests.

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[32] *Ibid*., 2.
[33] *Ibid*., 4.
[34] Roland Paris and Taylor Owen, "Introduction: A Transforming World," in *The World Won't Wait: Why Canada Needs to Rethink Its International Policies,* ed. Roland Paris and Taylor Owen (Toronto: University of Toronto Press, Scholarly Publishing Division, 2015), 1.
[35] John J. Mearsheimer and Stephen M. Walt, "The Case for Offshore Balancing: A Superior U.S. Grand Strategy,"…70.
[36] *Ibid*., 72.
[37] Andrew Davies and Christopher Cowan, "Australia and Canada: Different Boats for Different Folks," *The Strategist, Australian Strategic Policy Institute* (21 December 2016): 1, https://www.aspistrategist.org.au/australia-canada-different-boats-different-folks.

2 – CANADIAN NEEDS IN THE ARCTIC AND THE EXAMPLE OF BRAZIL

Canadian Needs in the Arctic

With expanding shipping access in the Arctic, compliance and respect for Canadian sovereignty and control will be driven by necessity and convenience. That control must be backed by hard power assets to force compliance when necessary.[38]

We presently have limited means in the Arctic. Canadian ships are poor platforms for Arctic operations, being incapable of operating in ice-infested waters ,[39] and logistical support is limited.

Increased Submarine Proliferation in the Arctic

Other states in Canada's circumpolar region are expanding their submarine capabilities.[40] While the operation of American, Soviet, British and French SSNs in and near Canadian Arctic waters was a closely guarded secret, scientific data and information taken by American submarines made public by Vice-President Gore in 1998 showed a large number of voyages in the Arctic Ocean.[41]

The only means to truly gain situational awareness and control both above and below the Arctic ice is through an SSN capability. SSNs would allow Canada to patrol our Arctic, detect

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[38] Adam Lajeunesse, *The Canadian Armed Forces in the Arctic: Purpose, Capabilities, and Requirements* (Calgary: Canadian Defence and Foreign Affairs Institute, 2015): 7.
[39] *Ibid*.
[40] Senate, Standing Senate Committee on National Security and Defence, *Reinvesting in the Canadian Armed Forces: A Plan for the Future…*36.
[41] Rob Huebert, "Submarines, Oil Tankers, and Icebreakers"…, 818.

intruders, and establish a powerful presence where a number of important nations, including the US, question our sovereignty.[42]

Inadequacy of the Means Put Forth or Proposed Thus Far

Situational awareness in the Arctic is essential to exercise effective control, and the anticipated increase in shipping will require an accurate maritime picture. The proposed means to address this problem, including the new Arctic Offshore Patrol Vessel (AOPV); Air-Independent Propulsion submarines; air patrols and UAVs; and the Northern Watch program are inadequate.

Insufficiency of the AOPV

AOPVs are unable to break through ice greater than a meter thick, limiting operations to the June-October period, and requiring a Coast Guard icebreaker escort. Slow, with a stated speed of 17 knots,[43] the AOPV lacks force projection capabilities as the size and capacity of the AOPV was reduced to save money. [44]

Insufficiency of the Diesel-Electric Submarine (SSK) with Air-Independent Propulsion (AIP)

[42] Adam Lajeunesse, "Sovereignty, Security and the Canadian Nuclear Submarine Program," *Canadian Military Journal*, (Winter 2007-2008): 75.
[43] Senate, Standing Senate Committee on National Security and Defence, *Reinvesting in the Canadian Armed Forces: A Plan for the Future…*34.
[44] Ken Hansen, "The Underappreciated Importance of Naval Logistics to the National Shipbuilding Strategy," *RCMI Sitrep*, Volume 78, no.5 (September-October 2018): 6.

The Arctic under-ice environment is unsuitable for existing or developing AIP-powered submarines since they lack endurance, speed, versatility and the ability to surface safely in extreme conditions.[45]

To replenish air, SSKs (including all 4 non-nuclear AIP systems currently in service or under development) must surface and raise their snorkel at regular intervals, which is impossible under all but the thinnest layers of ice.[46] Given that AIP systems are not powerful enough to generate and clear the atmosphere following an onboard incident, they are unsafe for prolonged under-ice operations. [47]

Limitations of Air Patrols and UAVs

Canada patrols the Arctic periodically with available airframes. These are not all-weather platforms, have limited fuel endurance [48] and lack stealth.[49]

UAVs fly much longer than manned platforms, but are limited by the required satellite uplink unavailability due to orbital limitations in many areas of the Arctic.

Limitations of the Northern Watch Program

The classified Northern Watch Program blends various surface and underwater surveillance technologies to monitor activity and identify surface and subsurface vessels traversing the Northwest Passage.[50] Despite this capability, any sensor must be linked to

[45] David Dunlop, "The Case for Canadian Submarines," *Canadian Naval Review,* (1 October 2018): 1, http://www.navalreview.ca/2018/10/the-case-for-canadian-submarines.
[46] *Ibid*.
[47] *Ibid*., 2.
[48] Adam Lajeunesse, *The Canadian Armed Forces in the Arctic: Purpose, Capabilities, and Requirements*…, 9.
[49] Michael Byers, "Does Canada Need Submarines," *Canadian Military Journal*, (Summer 2014): 11.
[50] Adam Lajeunesse, *The Canadian Armed Forces in the Arctic: Purpose, Capabilities, and Requirements*…, 9.

enforcement, otherwise it does little to assert control or sovereignty, much like a security camera or alarm with no response from police or security forces.

The Challenges of Naval Logistics

The RCN has suffered from warship choices that unduly focus on speed and maneuverability at the expense of capacity and endurance.[51] Historically, the geostrategic environment caused the Navy to focus on local defence, assuming the ability to function at longer ranges with NATO support. [52]

Our sustainment ships are limited in capacity,[53] and, except for privately-owned mine sites, there is no place for Canadian ships to refuel in the Arctic. Options include refueling at sea from a Coast Guard vessel, or in Greenland.[54] The Nanisivik Naval refueling facility will create more capacity, but logistical challenges remain for sustained Arctic surface or underwater operations.

The Canadian Need for Submarines

Canada needs submarines to defend Canada and North America, support expeditionary operations and support Canada's global maritime security interests.[55] Submarines are likely to remain the dominant naval platform for the foreseeable future, and are thus an essential component of a balanced, combat-effective Navy.[56]

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[51] Ken Hansen, "The Underappreciated Importance of Naval Logistics to the National Shipbuilding Strategy"…, 6.
[52] *Ibid*., 11.
[53] *Ibid*., 7.
[54] Beth Brown, "Access to Fuel Essential for Royal Canadian Navy's Arctic Work," *Nunatsiaq News,* 5 September 2018.
[55] David Dunlop, "Canada's Future Submarines," *Canadian Naval Review* (25 September 2017): 1, http://www.navalreview.ca/2017/09/canadas-future-submarines.
[56] Department of National Defence, *LEADMARK 2050…,* 50.

A modern submarine fleet would allow Canada to defend its coasts, sea lanes, ports and harbours from sea mines and underwater threats, while simultaneously contributing to NATO and NORAD operations in a high readiness state.[57]

Submarines are weapons of strategic deterrence whose presence, actual or inferred, can alter adversary decision-making across an entire maritime theater of operations, by controlling a substantial ocean space or denying it to others.[58] During the Turbot War, a press release that a Canadian submarine was heading to sea had a major impact upon the Spanish Navy.[59]

Advantages of the SSN Option

Canadian submarines must operate for prolonged periods, at great distances, with unlimited endurance in some of the most unforgiving waters on the planet.[60] Although SSNs have higher upfront costs they have many advantages including:

Unparalleled Flexibility

Nuclear propulsion is superior in terms of surge ability, changing stations and staying on station,[61] without the encumbrance of fuel supply logistics. [62]

High-Power Density

The high density of nuclear power allows space for other cargo including spare parts, water, food, autonomous vehicles and weapons, giving the vessel more impact.

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[57] Senate, Standing Senate Committee on National Security and Defence, *Reinvesting in the Canadian Armed Forces: A Plan for the Future…*37.
[58] Department of National Defence, *LEADMARK 2050…,* 39.
[59] *Ibid*., 15.
[60] David Dunlop, "The Case for Canadian Submarines," …, 1.
[61] Jack Spencer and Baker Spring, "The Advantages of Expanding the Nuclear Navy," Heritage Foundation WebMemo (November 5, 2007): 1, http://s3.amazonaws.com/thf_media/2007/pdf/wm1693.pdf.
[62] *Ibid*.

Real Time Response:

A nuclear ship can change missions immediately.

Energy Independence

Oil dependence is a vulnerability. A submarine needing to replenish at one or two possible points (Nuuk, Greenland or Ninisivik), is predictable, and must remain within fuel range.

Survivability

Nuclear vessels require no supply line, are capable of operating over long distances, and produce large amounts of electricity to power radars and high-tech weaponry.[63]

Clean Energy

Conventionally powered vessels emit CO2 while nuclear ships are largely emissions-free.

Safety

The USN in 1987 had operated 103 reactors in 81 nuclear-powered ships for over 5800 reactor-years and steamed 136 million miles without a single incident.[64]

Superior Under-Ice Capability

Only an SSN has the ability to repeatedly surface through several feet of ice.[65]

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[63] *Ibid*., 2.
[64] *Ibid*., 3.
[65] David Dunlop, "The Case for Canadian Submarines," …, 1.

The Belief in the Need for a Canadian SSN Capability is Not New

The RCN began reviewing the possibility of acquiring SSNs in 1958. In 1987, the Defence White Paper portrayed the SSN as the ideal weapon for the RCN due to its unparalleled mobility and versatility.[66]

The Canadian Public accepted the need. In June 1987, public support for the SSN program was at 50% with only 37% opposed. [67]

Defence Update 1988-89 stated:

> "*One of the most challenging defence initiatives, which has caught the imagination of many and attracted the criticism of some, is the plan to acquire 10-12 nuclear-propelled submarines… They are the only vessels capable of exercising surveillance and control in the Arctic. There is simply no other way for Canada to defend its Arctic approaches."* [68]

On October 27, 2011 Defence Minister McKay told CBC News "… I know nuclear subs are what's needed under deep water, deep ice."[69]

Comparator Universe – The Case of Brazil.

Brazil is seeking influence over its offshore waters and resources through an SSN acquisition, in partnership with France.[70] The agreement includes a joint venture between French

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[66] Adam Lajeunesse, "Sovereignty, Security and the Canadian Nuclear Submarine Program"…, 75.
[67] *Ibid*., 81.
[68] Department of National Defence. *Defence Update 1988-89* (Ottawa: Minister of Supply and Services Canada, 1988), 10.
[69] Greg Weston, "Canada may buy nuclear submarines," *CBC News*, 27 October 2011.

Industrial Group DCNS and Brazil's Oderbrecht,[71] with training of Brazilian officials and technical staff, and the transfer of technology to build the non-nuclear part of the submarine. Brazil will complete the nuclear portion, enhancing the Navy's capabilities, and giving the Brazilian arms industry access to new markets with their new technologies.[72]

How Nuclear Energy Can be Used by the Military in a Non-Nuclear Weapons State

Brazil is expanding the definition of "peaceful use" of atomic energy for the military of a non-nuclear weapons state. Brazil is leading the way in terms of this legal innovation and implementing international safeguards.[73] A new safeguards agreement is under negotiation between Brazil and the IAEA,[74] paving the way for Canada.

Brazil's Need for an SSN

Both Brazil's President and Navy consider the SSN as crucial to the defence of the "Blue Amazon," the resource-rich area covering 4.5 million km^2 off Brazil's coast,[75] since an SSN can stay underwater longer and travel faster than conventional submarines. In the words of Fleet Admiral Gilberto Max Roffé Hirschfeld, General Coordinator of the Submarine Development Programme:

> We seek to expand our submarine force because we need modern, high-performance weapons to protect our vast maritime domain. Our coastline is 8,500 km in length and our EEZ covers over 4.5 million square kilometers. The sea holds

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[70] Admiral Bento Costa Lima Leite de Alburquerque Junior, *The Brazilian Navy's Nuclear and Submarine Program* (Washington: Wilson Center Brazil Institute, 2018), 8.
[71] Leonardo Bandarra, "Brazilian nuclear policy under Bolsonaro: no nuclear weapons, but a nuclear submarine," *Bulletin of the Atomic Scientists* (12 April, 2019): 5, https://thebulletin.org/2019/04/brazilian-nuclear-policy-under-bolsonaro/.
[72] *Ibid*., 4.
[73] *Ibid*., 5.
[74] *Ibid*.
[75] *Ibid*., 4.

> 90% of our hydrocarbon resources and is the gateway for 95% of our external trade…Through the Prosub program, and the acquisition of technologies needed to design and build conventional submarines while at the same time developing a homegrown nuclear propulsion capability, Brazil has for the first time adopted a national defence and sovereignty policy.[76]

Benefits to the Brazilian Economy and Economic Growth

This program involves outfitting construction and maintenance shipyards, and constructing a naval base, with high domestic industry participation.[77] The development of Brazilian nuclear propulsion strengthens Brazil's domestic industry with high-value jobs and technology transfers from France for the energy and technology sectors.[78]

The program involves 700 Brazilian companies, 18 universities and research institutes, and has created 4,800 direct and 12,500 indirect jobs,[79] with Argentina looking to partner.[80]

3 – BUILDING SSN NUCLEAR PROPULSION IN CANADA – COSTS AND BENEFITS

Only a handful of nations such as America, Britain and France currently produce SSNs. A built-in-Canada solution, supported by a foreign shipbuilder with submarine building experience, would be the best solution for leveraging domestic capability for building not only

[76] Vincent Groizeleau, "Update on Brazil's Submarine Programme," *Mer et Maritime*, 21 July 2017, 3. https://www.meretmarine.com/fr/content/update-brazils-submarine-programme.
[77] Admiral Bento Costa Lima Leite de Alburquerque Junior, *The Brazilian Navy's Nuclear and Submarine Program…,*11.
[78] *Ibid*., 7.
[79] *Ibid*., 6.
[80] Leonardo Bandarra, "Brazilian nuclear policy under Bolsonaro: no nuclear weapons, but a nuclear submarine"…5.

the submarines, but the necessary infrastructure and supply chain required to support these submarines throughout their service lives.[81]

[81] David Dunlop, "The Case for Canadian Submarines," …3.

SSN/AIP SSK Cost Comparison

Upfront SSN costs exceed AIP SSK costs, however the advantages outweigh the difference, both in terms of performance and benefits to the economy. As set out below, 6 SSNs would cost $20-22 Billion, and are a better option for Canada than 12 AIP SSKs which would cost about the same amount.

The Cost of AIP SSKs

12 German Type 216-based Boats would cost approximately $20 Billion.[82] The Australians recently ordered 12 French SMX Ocean-Class SSKs for AUD$20 Billion (approximately $22 Billion) excluding lifecycle costs, or $1.8 Billion per boat.[83]

The Cost of an SSN

Nuclear submarines cost about $3 Billion each.[84] Australia estimated a cost of about US$2.5. Billion to acquire the *Virginia* class SSN from the US. [85] In April 2014, the Pentagon announced it had gotten the price down to US$1.76 billion per unit. [86]

Brazil's SSN will cost US$2.4 billion with about US$1.5 allocated to the reactor. [87]

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[82] David, Dunlop, "Canada's Future Submarines"…, 2.
[83] *Ibid*.
[84] Greg Weston, "Canada may buy nuclear submarines,"…, 3.
[85] Zachary Keck and Henry Sokolski, "South Korea is About to Make a $7 Billion Nuclear Submarine Blunder," *The National Interest* (30 September 2017), 4. https://nationalinterest.org/blog/the-buzz/south-korea-about-make-7-billion-nuclear-submarine-blunder-22540.
[86] Andrew Davies, "How to buy a submarine, American style," *ASPI Strategist,* (13 May 2014): 1, https://www.aspistrategist.org.au/how-to-buy-a-submarine-american-style/.
[87] Zachary Keck and Henry Sokolski, "South Korea is About to Make a $7 Billion Nuclear Submarine Blunder"…, 5.

Economic Benefits for Canada of an SSN Acquisition

The Impact on the Canadian Economy

SSNs are expensive in terms of upfront costs but the advantages outweigh the costs in terms of performance and economic impact, for both the Defence and Canadian Nuclear Industry. Like Brazil, a built-in-Canada solution, supported by a foreign shipbuilder with submarine building expertise,[88] would result in significant technology transfers and high-paying job creation.

Supporting a Vibrant Canadian Defence Industry

An innovative and dynamic defence industry contributes importantly to both sovereignty and economic growth. [89] It is in the national interest to have a strong defence industrial base that goes beyond basic capability maintenance and repair to the actual production of key goods and services.[90]

Almost all Canadian-based defence suppliers of scale started with a DND contract. This first contract often validates a product outside the domestic market. The return on this investment includes high-value Canadian jobs in the short-term, but more importantly the creation of high-growth companies over the long-term.[91]

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[88] Tom Jenkins, *Canada First: Leveraging Defence Procurement Through Key Industrial Capabilities* (Canada: Public Works and Government Services Canada, 2013), 3.
[89] *Ibid*.
[90] *Ibid*., xiii.
[91] *Ibid*., 5.

Supporting the Canadian Nuclear Industry

Canada's Nuclear Industry is a $6 billion domestic industry and a strategic asset, providing 30,000 direct and 30,000 indirect jobs. Many of these jobs are high-skill and involve cutting-edge technology, positioning Canada as a leader in science, technology, engineering, high-quality construction and clean tech.[92]

Development of Nuclear and Small Modular Reactor (SMR) Technology

Like Brazil, Canada could develop its own nuclear systems to propel both SSNs and icebreakers, and to provide emissions-free electricity to both Canadian industry and remote communities.

Leveraging 70 Years of Canadian Nuclear Expertise

Canada has developed its own line of nuclear reactors starting with the Chalk River reactor in 1957.[93] Canada is one of only a few top-tier nuclear countries with over 70 years of experience and investment, and has some of the world's best uranium resources.[94]

Building a SMR Industry in Canada

Grid-based nuclear in Canada can take the form of large reactors such as the Canadian Home-Grown Enhanced CANDU 6 reactor, large light water reactors, and SMRs.[95] SMRs are

[92] Generation Energy, *Vision 2050, Canada's Nuclear Advantage* (Ottawa: Canadian Nuclear Association, 2017), 6.
[93] World Nuclear Association, "Nuclear Power in Canada," last modified [or accessed] 18 May 2019, http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/canada-nuclear-power.aspx.
[94] Generation Energy, *Vision 2050, Canada's Nuclear Advantage*…, 11.
[95] *Ibid*., 3.

defined as nuclear power reactors with a standardized modular design and an output of less than 300 Megawatts Electric (MWe).[96]

The first SMR was built in the US to power the first SSN: the *USS Nautilus.*[97] There has been a significant effort worldwide to develop SMRs as emissions-free, economically competitive alternatives to large nuclear power plants to power remote communities and help with resource extraction.

Powering Remote Communities. Canada has over 50 remote northern communities that are powered by 1MWe diesel generators. This requirement is too small for a 300MWe SMR. By producing smaller SMRs, Canada could make this form of electricity and district heating feasible.[98]

Reducing the Carbon Footprint of the Oilsands. Nuclear energy can not only be used to produce electricity, it can also be used to produce the high-quality industrial steam needed to extract the bitumen from the Oilsands.

Building a Canadian SMR industry would significantly impact the economy and increase GDP. The required facilities would require billions of construction dollars, creating thousands of jobs for construction, and then hundreds for operations. Exports would create additional manufacturing jobs and opportunities for collaboration on R&D and regulation.[99]

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[96] Moore, M., H. Sam-Aggrey, H. Hanke, M, Yetisir and W. Hahn. "A Review of Small Modular Reactors: The Canadian Applications and Impacts," Paper presented at 14h Annual Conference on Clean Energy, Saskatoon, 27 September-01 October 2015, 1.
[97] *Ibid*.
[98] *Ibid*., 3.
[99] *Ibid*., 4.

CONCLUSION

Arctic Climate change is expanding access for shipping and resource extraction, and state military capabilities are expanding. Russia has returned to the region in force, and China, declaring itself a "Near-Arctic State," is increasingly assertive with the expansion of the Chinese Navy and the building of the "Polar Silk Road."

Demonstrating to the world that Canada has the will and capability to assert sovereignty over our Arctic seas will be increasingly important as global warming opens the Arctic for resource exploitation.[100] Canadian capabilities, including the AOPV, are currently incapable of meeting this goal.

Like Brazil, Canada should build 6 SSNs, supported by a foreign shipbuilder with submarine building expertise.[101] Although SSN initial upfront costs exceed AIP SSK costs, the advantages outweigh the difference, both in terms of performance and benefits to the Canadian economy

Building 6 SSNs would allow Canada to patrol our Arctic, detect intruders, and establish a powerful presence where a number of important nations, including the US, question our sovereignty.[102]

A built-in-Canada SSN, with significant technology transfers, would spread economic benefits across the country and leverage domestic capability arising from the National Shipbuilding Strategy.[103]

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[100] David, Dunlop, "Canada's Future Submarines"…, 2.
[101] *Ibid*., 3.
[102] Adam Lajeunesse, "Sovereignty, Security and the Canadian Nuclear Submarine Program"…, 75.

Without SSNs, Canada cannot exercise authority within its own waters, a central requirement of national sovereignty.[104] Allowing the USN to continue providing Canadian Arctic security not only weakens our claim to the Northwest Passage, it completely undermines our sovereignty.[105] In the words of Perrin Beatty: "a nation that contracts-out the security and defence of its own territory is not sovereign, but a protectorate." [106]

Word count: 4054 – 262 headings – 493 indented quote = 3299 words

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[103] David Dunlop, "The Case for Canadian Submarines" …3.
[104] *Ibid*., 2.
[105] *Ibid*.
[106] Perrin Beatty, *The Globe and Mail,* 20 July 1987.

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