CANADIAN GLOBAL AFFAIRS INSTITUTE
INSTITUT CANADIEN DES AFFAIRES MONDIALES

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ROUNDTABLE REPORT

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On 10 December 2024, the Canadian Global Affairs Institute hosted a roundtable discussion on NORAD Modernization initiatives, *Our North, Strong and Free* (*ONSAF*), and federal energy and carbon reduction strategies, hosted by KMPG. The intent of this session, held under the Chatham House rule of non-attribution, brought together key federal government stakeholders to better understand the collective implications of planned northern investments as well as the anticipated energy requirements and objectives to understand the role that technologies like Small Modular Reactors (SMRs) might play.

DND's Northern Plans: Energy Requirements for ONSAF and NORAD Modernization

The Government of Canada has set out an ambitious agenda for Canada's Arctic. The new defence policy, *Our North, Strong and Free* (*ONSAF*), outlines an expanded presence, staging of capabilities, and force projection in the region. The billions of dollars for proposed defence modernization investments represent a tremendous opportunity to strengthen the capabilities of the Canadian Armed Forces (CAF), provide dual-purpose infrastructure for Northern communities, and strengthen Canadian sovereignty and security through presence and resiliency.

From a defence perspective, these investments represent an extraordinarily difficult challenge. Given climate change and goals to reduce carbon emissions, delivering resilient and sustainable infrastructure with modern and reliable energy solutions can create development some of these proposed investments in a comprehensive way. To ween Canada's Arctic off of its reliance on diesel as the only energy source, pilot projects are underway to look at solar, geothermal, and micro and small modular nuclear reactors. This research and development has potential to be game changers from Canadian defence and industrial capacity perspectives.

Canada's recently announced Arctic Foreign Policy, NORAD Modernization commitments, and *ONSAF* show that the Arctic can no longer be neglected (which it has been by successive governments) for investment to defend and secure Canada. Forward Operating Locations (FOLs) in Yellowknife, Iqaluit, and Resolute Bay require modernization for new assets like the F-35, of which Canada has announced plans to buy 88. Canadian Forces Station Alert, the northernmost base on the tip of Ellesmere Island, has airstrips, structures, and buildings which are subject to the harshest of cold weather climates. Future FOL sites are being determined, balancing factors of energy bandwidth requirements, the ability to provide power to these locations, and strategic viability. For example, Canadian Forces Base Goose Bay in Labrador uses 6 million barrels of diesel

yearly to generate electricity. This becomes a costly resupply issue for future FOL locations should there be limited or non-existent electrical grids nearby.

The North Warning System (NWS) has many remote sites that run off diesel generators, but these must be resupplied periodically (normally by barge) which creates further logistics and maintenance costs. NWS sites were originally picked for their strategic importance without consideration for the climate impacts of diesel to power the radars. Small Modular Reactors (SMRs) may offer a solution, but security considerations, price, and public discourse around their safety are obstacles.

National Defence is a large emitter of carbon emissions, representing half of the Government of Canada's footprint. Resupply logistics for NWS sites is challenging, with stockpiles of up to 36 months of fuel due to its remote locations. Much of the non-diesel energy technology today is close to 30 years old. Geothermal, solar, wind, and other non-fossil fuel energies are unlikely to be consistently reliable due to the cold temperatures. Defence Research and Development Canada (DRDC) is looking at solutions through its AMAZE program to use different renewables, battery storage options and backup generators to switch power supply systems.

Additionally, some of the new capabilities require extra infrastructure to support. As an example, it was mentioned that an F-35 cannot idle outside on a tarmac to defrost its windows and needs to be stored in a controlled environment. Climate change-induced temperature changes and permafrost melt are changing the nature of energy requirements that are both future and soldier-proof (such as needing air conditioning in hangars in the North). These power systems are expensive, as new weather patterns require more complicated heating and cooling systems for infrastructure in remote locations, and air freight costs to fly in technicians to repair and maintain are fiscally prohibitive. Shortfalls in meeting sustained energy needs could be addressed by turning to the private marketplace to find solutions, especially if something other than SMRs can be delivered and deployed quicker.

There is a major sense of urgency to advance the timeline with all modernization projects, as Canada is "behind the threat." This underpins the need to find novel solutions and accelerate timelines, even as the complexity of the Canadian Arctic further adds to the problem set.

Energy is the main concern for upgrades to FOLs, Northern Basing Infrastructure, and the Polar Over-the-Horizon (POTHR) radar line. DRDC is working on solutions to power these site locations, beyond having to barge in fuel. Some FOLs already have power for

lodging, cooking, and two hangars large enough for an Airbus A-330, but these sites will become more power hungry which requires more fuel, generators, and jet fuel. The NWS, with sites that were modernized from the Distant Early Warning (DEW) Line, are largely uncrewed. Should these sites be converted to POTHR, SMRs have a large security requirement which would mean a correspondingly large human presence and change community dynamics and ways of life. Ensuring the POTHR has sustained power for the long-term and ability to maintain it is a challenge in terms of technology and policy.

The Arctic Over-the-Horizon (AOTHR) radar line in Southern Ontario will provide NORAD with increased situational awareness and sites are being chosen based off their strategic contribution. In contrast, the best place to locate the POTHR will be based on DND's ability to power the technology, potentially limiting the effectiveness of the system, what the radar can pick up, and may require terraforming to build.

ONSAF projects also mean an increase in the number of sensors. They are unlikely to be in locations which are convenient from a power or energy perspective as sensors need to be effective against a threat. Geographically strategic sites, yet inconvenient to ensure constant power supply, also applies to possible Integrated Air and Missile Defence (IAMD) systems (which are considered "explore" projects in *ONSAF*), such as ground-based interceptor systems.

ONSAF outlines plans to augment presence in Iqaluit and Inuvik FOLs, with increase in demand for steady, stable, reliable, and predictable power supplies. DND cannot plan long-term with a reliance on diesel. Iqaluit is a territorial capital utterly reliant on diesel as its only power source; finding a new sustainable source has civilian community-building positives and military benefits.

There is a growing sense of understanding for the energy demands and basing requirements for potential locations housing submarines, fighters, and tankers. The NORAD Northern Basing Infrastructure (NNBI) project has 50-60 sub projects such as buildings, airstrips, and operations centres. Energizing these projects is a major challenge, as communities require upgrades to current electrical systems, grids, generator capacities, fuel storage, and overall requirements for demand. Neither National Defence nor DRDC has a total amount of power supply requirements for its infrastructure and base portfolio, which includes 13,000 buildings.

The services also do not have aggregate energy consumption and power capabilities required. For example, Goose Bay uses 26,000 megawatt hours, 6 million barrels of light fuel oil, and 30,000 barrels of diesel yearly. The harsh environment of the Canadian Arctic

does not permit the luxury of having only one energy source, with all but two NWS sites having barging capabilities and have outbuildings with their own generators for redundancy and resiliency.

DND/CAF has limited ability to distribute power within its own bases. Ontario's Hydro One cannot provide sufficient power to some bases and is anticipated to be unable to meet demand by 2030. Bases require major internal upgrades to energy systems, but it is equivalent to wiring an old house for electrical vehicle charging. Upgrades require knowledge of how much power is needed, the best way to provide it, the subsystems "inside the fence line" that will distribute it, and a redundant backup system which stays online in expected and unexpected maintenance periods.

National Defence's Infrastructure and Energy branch are in the process of digesting portfolio requirements from *ONSAF* by prioritizing, "spec-ing" capabilities, staging, and designing for development. Constraints include the availability of engineers and architects and ensuring local markets can absorb DND investment without drawing out the workforce from private and other government investments. *ONSF* did not provide the Government of Canada additional internal resources and *Strong, Secure, and Engaged* (*SSE*), the previous defence policy, is still being worked on with priorities sequenced.

The Canadian Coast Guard

The Canadian Coast Guard (CCG) is seized building a "fleet for the future" with the Offshore Oceanographic Science Vessels, Arctic Offshore Patrol Vessels 7 and 8, Polar Icebreakers, and scientific research ships. Successive governments have made capital and fiscal frameworks to replace the CCG entire fleet but still requires resources to maintain the vessels and shared marine infrastructure investments with the Navy (RCN).

The CCG is building a permanent footprint in the Arctic and has been operating in the region for 55 years. There is a Regional Headquarters in Yellowknife and Marine Traffic Services Centre in Iqaluit, with environmental response and Search and Rescue (SAR) based out of these two hubs. Its seven icebreakers are sent to the Arctic annually, operating late June to early December.

CCG modernization needs are centred around infrastructure to support ship-to-ship refueling transfer and powering its ships with diesel alternatives. The Near-Shore Fishery Research Vessel is powered by a sub-energy system of biodiesel. The CCGS Sir Wilfrid Laurier transited the Pacific to Japan successfully on a blend of fuel that was only 10% diesel. Additionally, solar panels and batteries could help power CCG radar sites for

marine navigation on the west coast which are difficult to access, reducing diesel consumption by 90%.

In Yellowknife, plugging into the grid can be questionable as you do not want to draw power availability and needs away from the community, and as the Government of the Northwest Territories has challenges with meeting power supply demands today. The federal government plugging in anywhere in the North is a significant issue, as the grids cannot handle the influx of electricity demand. Provinces and territories are going to be challenged to meet the power demands new CAF/CCG capabilities require, which further highlights the need for redundant energy sources with resilient infrastructure for weather, adversaries, and energy command.

The CCG is thinking in a whole-of-society approach, with an emphasis on ensuring soft civilian targets are not at risk. Co-development with Inuit regionally, in a holistic and trusting manner, allows CCG to get at problem sets differently by working with a deep understanding of traditional knowledge and skillsets that are community specific.

Government needs to lead the way on upgrading capabilities, informing industry of what is needed and required by the services and Coast Guard. There is a lack of overall leadership for a whole-of-government solution, which is not National Defence's role to play. DND, CCG, other government departments like Transport Canada, communities, and vessel traffic all have energy requirements which requires collaboration and communication.

Enabling sovereignty means having a CCG that has deployable vessels to break ice, conduct Search and Rescue, clean up oil spills, have refueling provisions available to domestic and international vessels, resupply communities, and support government operations. What is more, the Northwest Passage remains difficult to navigate, with only 50 vessels transiting in 2024. These are practical applications of sovereignty and opportunities to exert it, crucial to Canada's prioritization of the Arctic as a region vital to our safety and security.

Natural Resources Canada

Nuclear energy development has long timelines, with "soon" in the sector representing 15 years. Reactors have long construction timelines that are capital intensive. Current SMRs are 10th generation water reactors, but energy outputs change depending on design. An SMR is equivalent to anything under 300 megawatts, which is like saying a car is

something that has four wheels. It is possible that backup diesel power and diesel generators will always be needed to power military infrastructure in the North.

NRCAN's SMR Roadmap and Action Plan from 2018 highlights different applications for SMRs for Canada, such as grid scale electricity in Darlington, Ontario (through 4 reactors just east of Toronto which creates electricity for 2 million people), heat generation from 4th generation reactors, and for remote and industrial operations. SMRs are very expensive, with design costs climbing to as high as $1 billion per reactor, and the theory that SMRs get cheaper over time has not been proven true as each reactor is tailor made for a specific purpose. For example, McMaster University in Hamilton, Ontario is looking at SMRs as solutions to power its campus, with the remaining energy used to power its heating systems. The U.S. Army uses a subset of the SMR, the Micro Modular Reactor (MMRs), which are transportable and use high temperature gas to create energy. However, SMRs and MMRs cannot be "plugged in" in tandem and require specialized skillsets to operate, maintain, fix in crisis, and security considerations, which may be a draw on communities in both Northern and Southern Canada. The U.S. Army has created their own training programs for operations of their MMRs.

NRCan is in initial planning phases for a new nuclear emergency strategy to address fundamental policy questions about where Canada wants to put its efforts when it comes to modular reactors. Technological research and development is underway on transportable power plants centred around MMRs, which can be fueled for 5-15 years depending on its size and then unplugged from the grid and sent south to be disposed of safely at the end of its lifespan. A challenge for Canada is over intellectual property and how much defence and security organizations must rely on civilian agencies to power their infrastructure needs, meaning National Defence cannot license this technology like the United States Department of Defense does.

There are approximately 31 CANDU (Canada Deuterium Uranium) reactors and 18 derivatives globally relying on Russian-enriched fuel, but the U.S. and U.K. are building out the capacity for refinement. The Advanced CANDU Reactor 9 was not purchased to expand the Darlington Nuclear Generating Station in 2009, but Canada's largest construction firm, AtkinsRéalis Group. is marketing 300MW SMRs as quicky-deployable, simplified, and compact option.

SMRs and Fusion

Eielson Air Force Base in Alaska has been chosen as the U.S. Air Force test site for a MMR, but the decision is currently undergoing regulatory dialogue. The Russians are also working on deploying their first land-based SMR in Ust-Kuyga in their Arctic, with expected commissioning in 2028. Other Arctic nations have yet to successfully use this energy technology to power their military installations notwithstanding the difficult topographical and geographic considerations for building infrastructure in the Canadian Arctic – this includes permafrost melt and bedrock drilling. The NATO Climate Change and Security Centre of Excellence (CCASCOE) in Montreal is working on sharing information about what allies are doing when it comes to energy and climate change considerations in their Northern climates.

There is an increased security aspect to protecting SMRs compared to diesel generators and pipelines. While fuel is enriched low enough that it cannot be weaponized, sabotage, the physical security of the equipment, shutdown procedures, and educating local communities on the technical specifications all are considerations and challenges. It was further mentioned that the ability and likelihood of state or non-state actors physically removing fuel or energy sources from an SMR built in the North for nefarious purposes is minimal due to the presence and knowledge of local leaders and elders who have the situational awareness of who is in their community. Utilizing Canadian Rangers, who live and work in their home communities and are trusted sources of knowledge and maintain CAF presence, often oversee protection and security of critical infrastructure in their communities such as NWS sites.

When it comes to the question of using SMRs to power Canada's defence modernization capabilities, it is fundamentally about political will and money. Fiscal constraints are a large part of this equation, which is a politically difficult conversation given the price tag in this economic climate. This is especially sobering given a CANDU reactor costs $15 billion to build and Canada has not built reactors since the 1990s and relies on private corporations. France, South Korea, China, and Russia have nationalized or have state-owned nuclear energy technology – Canada and the United States are the only private owned states of the nuclear powers. The political climate to support nuclear energy is fleeting, even if current and future federal governments are pro-nuclear energy, one accident or issue could scuttle public support.

Discussants also spoke of a whole-of-society "pull" strategy which places nuclear energy as the solution to solve non-renewable fossil fuel extraction, powering critical mineral mining operations, and solves the CAF's ability to power its infrastructure and project

"sovereignty." Essentially, coalesced demand across industries and sectors can bring together solutions to several different issues and drive economic output.

Concluding Thoughts and Future Considerations

- A social license needs to converge with political will and money. This is actively being worked on through exploratory roundtables in the Arctic, by predisposing communities to the technology. The Premiers of Yukon and Nunavut have expressed interest.

- Participants stated that they encounter pushback from communities, stating that some locals in the territories call radium "the rock that kills."

- Ensuring a baseline of education needs to be provided at the same time as the technology is development by working with the communities and answering their questions and listening to their concerns.

- If Canada chooses to pursue SMRs, it is possible we buy the technology from the United States. However, it is not yet ready for deployment.

- Industrial bases that build marine vessels are likely to get on board because they operate in the North and can see profit from supporting SMRs.

- Canada's history of military development in the North shows that approach has had unintended and deleterious consequences for Inuit. Working hand-in-glove with local communities is not only the right thing to do, but it is necessary and in line with the Government of Canada's 2019 Arctic Northern Policy Framework (ANPF) essential principle of "nothing about us without us."

- Buy in from political organizations, such as Inuit Tapiriit Kanatami (ITK), the national body protecting and representing the advancement of rights and interests of Inuit in Canada, could lead to a top-down approach to co-development. ITK is seized with getting communities off of diesel.

- Inuit have made enormous progress in achieving greater autonomy and self-governance, as exampled by the Inuit-Crown Partnership Committee in May 2024 which is essential to reconciliation.

- Canada adopted the United Nations Declaration on the Rights of Indigenous People (UNDRIP) in 2021 which means that Canadian laws are consistent with the declaration and Inuit legal agreement.

- All projects in Canada's Arctic require dedicated and sustained political will and money.

- The Canadian government is recognizing that economic and national security are the same consideration, which is further tied to critical minerals. There is a need to address challenges with respect to the development of critical minerals and rare earth mines in the Canadian North.

- Chief of the Defence Staff Carignan has publicly stated Canada will be on a war footing in 5 years' time. How can 20-year timeframe investments be crunched into a shorter time? How can policy and decision makers connect interests, strategies, and objectives into a coalescent state of readiness?

- This is not solely a defence problem and should not solely be on the shoulders of National Defence to solve. Committing to 2% of GDP on defence is a challenge requiring a whole-of-government approach and mobilization by coming together to identify ways and means to solve a problem set.

- The NATO Industrial Capacity Expansion Pledge and *ONSAF* creates the need to look at nuclear energy given its defence nexus and requires close collaboration with NRCan. This is also an opportunity to create a pull strategy on the Government of Canada for action.

- Saskatchewan Research Council has a second user lined up to use a nuclear energy reactor but cannot find a first because of concerns over its safety for the community.

- "First of" deployment will be the pick for broader national use because there is value to buying more and Canada is a market that can only afford one winner. Lots of stakeholders will be interested and buy but refuse to commit to being first.

- Socialization of ideas and solutions can come from non-government voices in communities and with political decision makers, who need to hear from many different corners.

- Proposal of an MMR Secretariat to advance education on the technology,

- Programs like Canadian Northern Economic Development Agency's IDEANorth promotes economic development in the North in order to strengthen territorial economies and increase economic participation by Northerners.

- Initial operating capability for *ONSAF* projects is in the 2035-2040 timeframe. The "explore" projects of *ONSAF* (Northern Operational Support Hubs (NOSH), submarines, and Integrated Air and Missile Defence (IAMD)) are being assessed and worked.

- There is a need to provide reactor specifications and be up front and speak plainly about the technology to be able to move forward on choosing a solution.

- A demonstrated need for cross-governmental mapping of all Government of Canada needs from departments and communities to understand power requirements, transmission challenges, geography, and technology points of view.

- Ongoing work is underway to understand how SMRs can be sited with permafrost melt and degradation.

About the Author

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Canadian Global Affairs Institute

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