DEEP DIVE DEBRIEF

Strategic Stability and Competition in the Arctic

CSIS BRIEFS

By Rebecca Hersman, Eric Brewer, and Maxwell Simon

JANUARY 2021

THE ISSUE

This brief is the third in the CSIS Project on Nuclear Issues (PONI) Deep Dive Debrief series that explores emerging or contentious nuclear challenges. These briefs are based on a series of "deep dive" workshops convened by PONI that bring together next generation technical, operational, and policy experts from across the nuclear community to debate and discuss these nuclear challenges. This brief reflects discussions and insights from a deep dive workshop convened by PONI at Kings Bay Submarine Base on strategic stability and great power competition in the Arctic. This brief focuses on how climate, economic, and political trends in the Arctic region impact U.S. strategic interests, and the implications of these trends for nuclear stability, policy, and posture.

The Arctic is growing in geostrategic importance and potentially becoming yet another zone for strategic competition, as this previously impenetrable territory becomes increasingly accessible to navigation and exploitation. The region is resource rich: it is estimated to contain 13 percent of the world's undiscovered oil reserves and 30 percent of its natural gas reserves.[1] Diminishing sea ice coverage is opening travel routes that can significantly shorten travel times between Europe and Asia. Traditionally, the Arctic states have relied on cooperative governance to manage competing interests in the region. However, as Arctic temperatures increase, new economic, scientific, maritime, and political opportunities are raising the question of whether the region will become more militarized and further engage competitive dynamics between the United States, China, and Russia.

Russia—whose military footprint and resources in the region dwarf those of the United States—has reinvigorated its military posture and become more assertive in the Arctic in recent years. Russia's military modernization across the Kola Peninsula over the last decade, which serves as Russia's Northern Fleet headquarters and as the primary home of Russia's sea-based nuclear deterrent, indicates the growing importance of the Arctic to Russia's power projection capability. In June 2020, the first of Russia's fourth-generation Borei-A-class submarines (SSBN) entered service with the Northern Fleet.[2] These submarines are capable of carrying 16 Bulava submarine-launched ballistic missiles (SLBM) and are stealthier than the aging third-generation Delta III- and Typhoon-class SSBNs. Moscow is also seeking to control and profit from access and transit rights in the region. China also increasingly views itself as an Arctic player, terming itself a "near-Arctic" state and bolstering its regional influence through investments in energy and infrastructure projects throughout the region.

The Arctic's growing geostrategic significance is driving an increase in U.S. attention to the region's security and

stability. In July, the U.S. Air Force released its new Arctic Strategy, which calls for enhancing cooperation with allies, improving domain awareness, and preparing for the likely increase in future Arctic operations.[3] Later that same month, the Trump administration appointed the first U.S. coordinator for the Arctic region, a position that had been unfilled since the end of the Obama administration (then referred to as the U.S. special representative for the Arctic).[4] In August, the United States also conducted joint B-52 flights with the Norwegian Air Force over every NATO member nation and docked a U.S. destroyer and fast-attack submarine at a newly expanded port in Tromso, Norway, 190 miles above the Arctic Circle.[5]

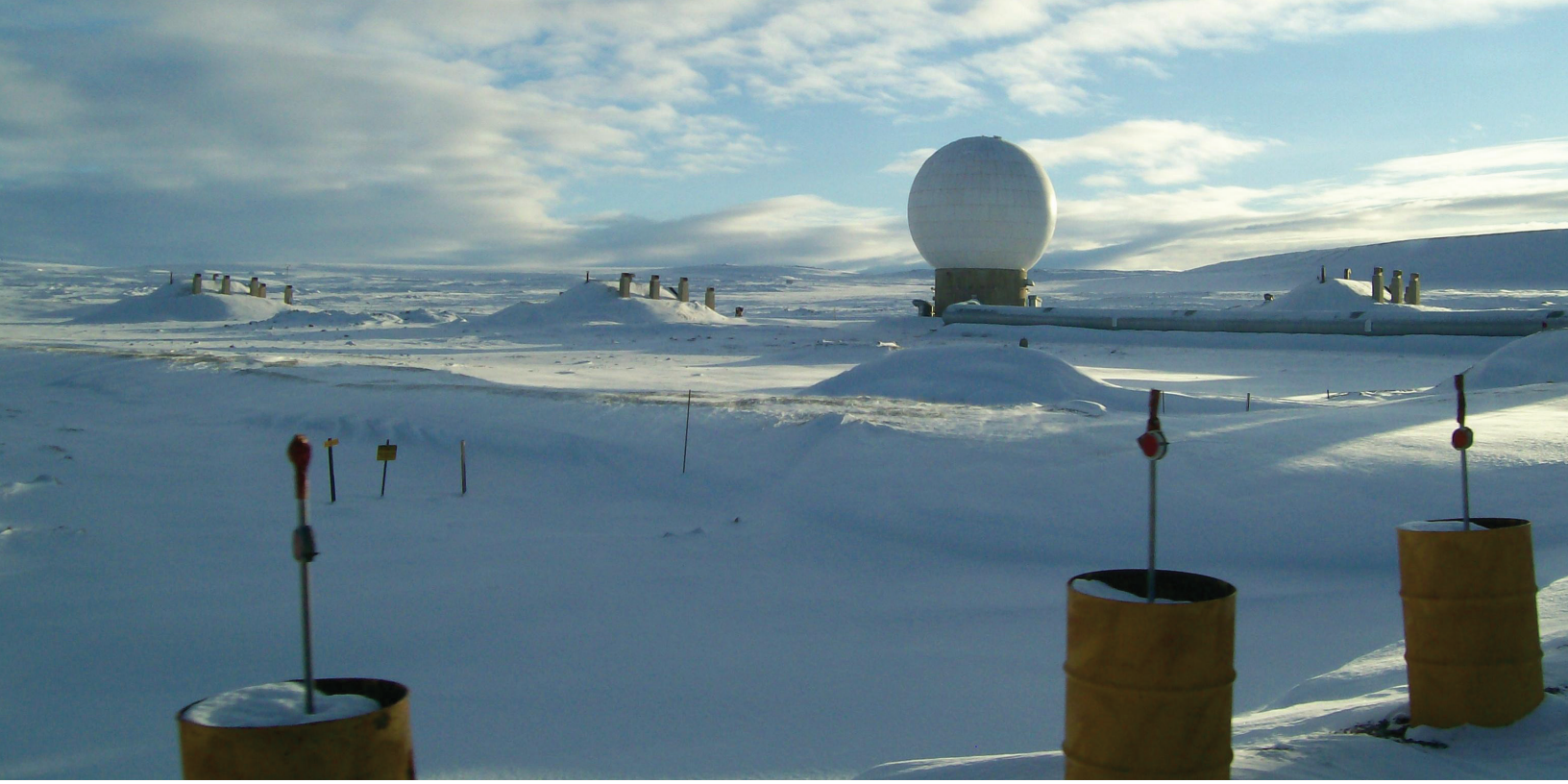
How can the United States manage competition with Russia in the Arctic without costly arms racing or destabilizing dynamics?

Nonetheless, while the United States views the Arctic as growing in strategic importance, resources have been slow to shift toward the region, especially in light of priorities and pressures elsewhere. In order to achieve its objectives in the Arctic and effectively manage competitive dynamics with Russia and China while reinforcing regional stability, the United States must answer several important questions: How can the United States manage competition with Russia in the Arctic without costly arms racing or destabilizing dynamics? Does effectively competing with Russia and China require the United States to alter its military posture in the Arctic, or will competition in the region focus on economic and political dynamics? How might climate, economic, political, and security trends reshape U.S. relationships with allies and partners as well as adversaries in the region?

KEY OBSERVATIONS

Receding sea ice, land ice, and permafrost is fundamentally changing the Arctic security and economic landscape. The speed with which Arctic ice is melting has far surpassed predictions made as recently as 2006. Sea ice is now declining at a rate of 12.85 percent per decade,[6] and according to the Intergovernmental Panel on Climate Change, temperatures are rising twice as fast in the Arctic as compared to the global average.[7] Parts of Alaska's coasts have eroded as far as 2,500 feet over the last 60 years as melting permafrost weakens soil, water from sea ice creates stronger waves, and rising temperatures lead to

Source: "Arctic Sea Ice News & Analysis," National Snow & Ice Data Center, December 2020, http://nsidc.org/arcticseaicenews/



Missile warning radar stations at the United States' Thule Air Base in Greenland

JoAnne Castangna/U.S. Army Corps of Engineers.

stronger storms. A recent study found that 69 percent of all current Arctic infrastructure is located in areas where permafrost is projected to thaw by 2050.[8] The Department of Defense has warned, for example, that coastal erosion and thawing permafrost will increasingly present structural challenges to early-warning radar sites and communications infrastructure at Air Force bases in Alaska and Thule, Greenland.[9] Indeed, at least three long-range missile warning radar stations in Alaska—part of the Air Force-operated Alaska Radar System—already face climate-based threats to infrastructure as a result of coastal erosion and thawing permafrost.[10] As a result, militaries will need to rely on offshore deep-water ports and adaptive architecture to ensure military and commercial installments are not further degraded.

These climate trends will reshape economic, energy, and trade opportunities in the region. As natural gas, oil, and rare-earth elements become more accessible, surprising scientific and economic partnerships have formed between Nordic countries and Russia and China. The Northern Sea Route (NSR), dominated by Russia, shortens shipping times from European markets to China by up to 40 percent compared to other routes. Today, the NSR is navigable for only three to four months per year, but it is possible that melting icecaps and other developments could make this shipping route available year-round by 2030.[11] Changing conditions are creating the opportunity for partnerships between China and Russia to develop the NSR and extract natural resources along Russia's northern border. According to some estimates, by 2040 a third transit lane (known as the Polar Sea Route) will be navigable for most of the year, facilitating commercial shipping.

Russia's approach to the Arctic is rooted firmly its overarching national security objectives. In addition, Russia's thawing Arctic border has also led to a renewed priority for Arctic defense. Russia views the Arctic through its broader national security lens—including its perception of the threat posed by the United States—and Russia's military buildup in the Arctic along its northern border is consistent with its national security doctrine and defense strategy.[12] Russia houses over 80 percent of its sea-based nuclear deterrent, including at least 7 of its 10 SSBNs, along the Kola Peninsula.[13] Indeed, the Arctic plays a central role in Russia's strategic deterrence posture. In accordance with its "Bastion" defense concept, the Northern Fleet aims to maintain its second-strike nuclear capability by ensuring the survivability of its strategic submarine force with a range of highly integrated anti-access/area denial (A2/AD)

The Russian Knyaz Vladimir Borei-A-class submarine (SSBN) on sea trials in 2019. The first of Russia's Borei-A-class submarine entered service with the Northern Fleet in 2020.

Wikimedia/HoteitH

capabilities in close proximity, including coastal missile defenses, aircraft, and surface vessels.[14] Indeed, strategic bombers and anti-submarine aircraft routinely patrol over Arctic waters, and three bases located along Northern Sea Route choke points are outfitted with S-400 systems and Bastion-P cruise missiles.

Russia's Arctic military buildup and exercises suggest a focus on an echeloned defense to protect its territory and SSBN fleet—it is increasing the number of S-400 missile defense batteries across its Arctic territory; Kotelny Island and Novaya Zemlya are equipped with Bastion-P and Pantsir-S1 missile defense systems and backed up by advanced anti-ship missiles; and Moscow is conducting submarine patrols through maritime choke points such as the Greenland-Iceland-United Kingdom-Norway (GIUK-N) Gap.[15] Nonetheless, Russia's northern bastions are increasingly capable of taking on more expansive missions, potentially allowing it to project power and extend its influence into the NSR and Arctic.[16] This buildup could serve similar operational purposes to bastions Russia is creating in Kaliningrad and the Black Sea, where its military has similarly massed A2/AD capabilities, capable of engaging targets at longer ranges and serving as fortified forward basing for missions into surrounding areas.[17]

According to Russian officials and state press, the Russian government has resumed operations at over 50 Soviet-era military bases in the Arctic, including 10 radar stations and 13 air bases.[18] And, as Russian president Vladimir Putin announced in June 2020, Russia will elevate its Northern Fleet to the level of a de facto separate military district beginning in January 2021, highlighting the growing military and strategic importance Russia attaches to the region. (Russia has four other geographic military districts.)[19] Russia also believes that the United States intends to increase its economic and military presence in the region.

Testing of military readiness is frequent; the Northern Fleet conducted 4,700 exercises and 3,800 test combat training exercises in 2017, for example.[20] In October 2019, Russia ran its largest strategic nuclear exercise in the Arctic, Grom-2019, involving tactical and strategic nuclear forces (including a road-mobile RS-24 Yars ICBM) and all four of its naval fleets, indicating Moscow's willingness to mobilize

assets from all its military districts and utilize ballistic and cruise missiles to defend its Arctic territory in a conflict.[21]

The Kola Peninsula is central to Russia's nuclear deterrent. The centrality of the Kola Peninsula to Russian defense in its northwest dates back to the Cold War, when it stationed strategic bombers at what is now its Severmorsk-1 air base. After a period of relative inactivity and decline of its military installations on the peninsula following the collapse of the Soviet Union, Moscow is continuing to modernize and expand several bases located in and around the Kola Peninsula, including its Severomorsk-1 air base, Gadzhiyevo submarine base, and Okolnaya submarine support base.[22] The air base upgrades in particular are enhancing Russia's ability for A2/AD defense further from its northern coastline. Russia also houses much of its sea-based strategic nuclear deterrent along the Kola Peninsula, where it also periodically tests sea- and land-based ballistic missiles.[23] Moscow is reconstituting its SSBN fleet—it currently has four Borei-class fourth-generation SSBNs, with plans to eventually have at least 10 in total.[24] Moscow currently expects to complete its first eight ships by 2023 and the last two by 2027. Public reporting suggests five of these SSBNs will join the Northern Fleet, headquartered in Severmorsk on the Kola Peninsula, and five will be deployed to the Pacific Fleet.[25] The Kola submarine bases contain extensive submarine-launched ballistic missile (SLBM) storage and loading facilities, and Okolnaya may store nuclear warheads.[26]

Source: Sung-Woo Lee and Ju-Mi Song, "Economic Possibilities of Shipping through Northern Sea Route," The Asian Journal of Shipping and Logistics 30, no. 3 (December 2014): 415-430.

The growing closeness of Russia and China in the Arctic, and China's growing economic presence in the region more generally, pose new national security concerns for the United States. The emerging economic opportunity in the region raises the potential for growing collaboration between Russia and China. China's current interests in the region are primarily economic, as the NSR shortens transit times from China to Europe by 40 percent. Gaining greater access to Arctic oil would also reduce China's dependency on the Middle East, where its supply lines are potentially more vulnerable.[27] In 2013, China was granted permanent observer status to the Arctic Council. Beijing's 2018 Arctic White Paper indicates that it sees itself as a "near-Arctic" state—a position refuted by the U.S. Coast Guard and the State Department—and plans to create a Polar Silk Road by constructing infrastructure throughout the Arctic. The risk exists that Beijing's economic engagement could form the groundwork for a permanent military presence, consistent with its pattern of gradually advancing its overseas power projection through dual-use facilities (i.e., facilities that can serve both commercial and military purposes) in the Indian Ocean and Africa.[28]

Due to poor communications infrastructure and harsh conditions, operating in the Arctic is very resource intensive; commercial capital is hard to come by and therefore heavy economic investment in the region is often not viable. Chinese state-directed investment has filled this vacuum by funding projects with security and commercial value. Russia is already heavily reliant on Chinese capital to operate its Yamal liquified natural gas facility, for example. Chinese investment also accounts for over 10 percent of Greenland's economy and 6 percent of Iceland's.[29] China's involvement with exploration and extraction of rare-earth element (REE) deposits—which are important components in the manufacturing of U.S. weapon systems, including the nuclear-capable F-35—in the Kvanefjeld/Kuannersuit area of Greenland is particularly concerning, as China has demonstrated its willingness

to exploit its monopoly of REEs to punish states it views as threatening Beijing's interests. In 2010, for example, China restricted Japanese access in the aftermath of a dispute over the Senkaku Islands.[30] Already producing 80 percent of U.S. and global REE imports, their involvement in this project further strengthens their global monopoly.[31]

As China continues to build its Arctic presence, it is possible that Chinese financial leverage over Arctic nations—particularly Russia—will provide political advantages for Beijing. In the short term, their cooperative pattern could form a foundation for strategic partnerships in other regions.

There are indicators that the Sino-Russian relationship is getting stronger in the region. China's release of an Arctic strategy was not criticized by Russia, in contrast to Moscow's response to policy documents from Western countries. In addition, Russia and China carried out a series of large-scale military exercises together in August and September 2019 in the Barents and Norwegian Seas.

The risk exists that Beijing's economic engagement could form the groundwork for a permanent military presence, consistent with its pattern of gradually advancing its overseas power projection through dual-use facilities (i.e., facilities that can serve both commercial and military purposes) in the Indian Ocean and Africa.

One potential future scenario could be one in which China leverages Russian dependence on its investment for energy projects in the region for enhanced economic and military presence—a debt-trap lending model similar to Beijing's activity in the Belt and Road Initiative.

Arctic domain awareness gaps are a serious operational challenge. Arctic positioning, navigation, and timing (PNT), communications, and Earth observation infrastructure are currently insufficient to ensure U.S. operational readiness in the region. Satellites in geostationary Earth orbit do not effectively operate above 81°3' latitude due to orbital plane inclinations, leaving the northernmost part of the Arctic without coverage. Aurora and ionospheric disturbances caused during magnetic storms in the region also weaken the precision of satellites that provide PNT services. The North Warning System (NWS), a set of 11 long-range and 36 short-range missile warning radars jointly operated by the United States and Canada under the auspices of the North American Aerospace Defense Command (NORAD), is also reaching the end of its service life, requiring NORAD to select a notional successor early warning system by 2021 to ensure it is operational by the mid-2030s.[32]

The United States will likely need to improve its situational awareness capabilities in the region as maritime traffic increases to ensure safe sea and air navigation, search and rescue capabilities, and accurate environmental forecasting. Space-based infrastructure—including strategically positioned HEO satellites with remote sensing technologies—and strategically located ground stations will play a critical role for improved domain awareness and operational readiness.[33] These initiatives are especially important given reports that the Russian military plans to bolster its communication constellation over the Arctic. Thus, enhanced situational awareness capabilities are critical to maintaining strategic flexibility and the ability to defend assets in the Arctic.

Russian interests in the region are asymmetric with those of the United States. Given Russia's large economic and geographic stake in the region, trying to match Russia's presence—particularly its military presence—may not be realistic. Russian territory comprises approximately 53 percent of Arctic coastline, compared to just 3.8 percent from the United States. Whereas 15 to 20 percent of Russia's economy—and a projected $500 billion of its annual GDP by 2030—comes from Arctic resource extraction, U.S. oil comes from the United States' interior, and its Arctic economic footprint is seven times smaller than Russia's by some estimates (0.3 percent of annual GDP, though access to fish in the U.S. exclusive economic zone will become increasingly important as ice recedes).[34] And while a significant portion of Russia's nuclear deterrent is based in the Arctic, the United States does not permanently station any of its nuclear triad in the region. Thus, Russian interests are consistent with a large Arctic presence; so too should U.S. Arctic interests dictate its resource commitment to the region.

Since any nuclear cleanup effort would be complicated by existing communications and PNT gaps, the United States should consider working with Arctic states to improve operational readiness for a nuclear accident.

Nuclear safety is a critical concern. Reports indicate that Moscow has potentially conducted weapons tests at the Novaya Zemlya Islands that have produced nuclear yield.[35] More recently, an explosion of its Skyfall nuclear-propelled cruise missile offshore the Nenoksa Missile Test Site created the worst nuclear accident in the region since Chernobyl, killing at least seven people.[36] Thus, nuclear security is a central, yet underappreciated, concern in the Arctic. Since any nuclear cleanup effort would be complicated by existing communications and PNT gaps, the United States should consider working with Arctic states to improve operational readiness for a nuclear accident.

POLICY OPTIONS TO ACHIEVE U.S. OBJECTIVES IN THE ARCTIC

There are four broad Arctic strategies that could theoretically be pursued by the United States to achieve its objectives in the Arctic, accounting for the strategic asymmetries in the region. A *direct rebalance approach* would call for U.S. efforts to unilaterally improve military capabilities and unilaterally work to curb Russia's advantage through a competitive approach. A *coalition-based offsetting approach* would prioritize working with Arctic and near-Arctic allies to mitigate Russia's actions. A *domain-based offsetting approach* would require focusing on economic and resource aspects of competition in the Arctic zone to maximize U.S. advantages. Finally, a *stability approach* centers on enhancing transparency and pursuing areas of U.S.-Russia (and China) cooperation where interests overlap.

Participants argued that a direct rebalance would heighten Russia's threat perception, require immense resources, and be inconsistent with the United States' current economic footprint and overall interests in the region. This approach would likely heighten existing Russian fears, lead it to pursue a more aggressive strategy, and potentially undermine strategic stability. Given Russia's geographic proximity to the region and its resources, participants also agreed that establishing economic parity with Russia through a domain-based offsetting approach would be an uphill battle. As such, while U.S.-Russia dynamics may increasingly be framed in competitive terms, the United States should not seek to "match" Russia in the Arctic.

Instead, a hybrid of the stability and coalition-based offsetting approaches provides the best options to advance U.S. goals, recognizing inherent limitations. Under this framework, the United States should prioritize multilateral initiatives with allies—such as improving communications infrastructure and the ability to conduct search and rescue and ensuring year-round access and domain awareness—that pose less of a direct threat to Russia but improve U.S. ability to operate in the region. Washington should place an emphasis on gaining operational capabilities that allow for strategic flexibility. This includes steps such as ensuring that U.S. icebreaking capabilities are sufficient to conduct search and rescue or freedom of navigation operations in the Arctic.[37] Washington could also open the door to collaboration with Russia and China on comparatively less contentious issues (e.g., the environment) to try and incentivize more productive behavior. Fusing the stability approach with a coalition-based offsetting approach also gives the United States greater flexibility to pivot to other approaches if circumstances change or a conflict in another theater spills over to the Arctic.

RECOMMENDATIONS

- **Preserve access to the region.** The United States will need to build sufficient infrastructure in the Arctic to effectively operate in the region and gain the flexibility to adjust its presence in response to future developments. Over the long term, the United States should field three heavy and three medium icebreakers, in line with current recommendations from the White House.[38] Icebreakers and other ice-capable ships are required to support search and rescue operations and maritime control of Alaskan waters. The United States should build broad coalitions focused on shared interests such as emergency response coordination, commerce, and environmental issues. The Arctic Council and Arctic Coast Guard Forum are two examples of cooperation between the United States, Russia, and other Arctic states on shared environmental and safety interests. Washington should search for opportunities to work with Russia where possible, to incentivize it to pursue a cooperative path. Since there is no Arctic security forum that includes Russia, Arctic states should consider building upon

The 11th Arctic Council Ministerial Meeting met in Rovaniemi, Finland on May 7, 2019.

Arctic Council.

NATO's established dialogue channels with Moscow through the NATO-Russia Council.

- **Improve intelligence, surveillance, and reconnaissance (ISR) architecture.** Improving the communications and PNT gap in the Arctic requires coordination between commercial and national satellite systems, including low earth orbit (LEO) satellites in polar and near-polar orbits and highly elliptical orbit (HEO) satellites. The United States should consider investment in high-altitude balloons and patrol the region with unmanned aerial systems. Ground-based missile warning infrastructure—such as installations at Eareckson Air Station, Clear Air Force Station, and Thule Air Base—will need to be maintained and made more resilient to climate-driven threats such as coastal erosion and melting permafrost.[39] Meanwhile, the radars that comprise the Alaska Warning System and North Warning System will need to be replaced entirely by the mid-2030s as they end their service life.[40] Importantly, these efforts will need to be paired with improved data collection capability across all domains, including land, maritime, subsurface, and especially the space domain, given the Arctic's harsh operating conditions. The Air Force Arctic Strategy properly outlines a greater role for the Space Force in the Arctic, but sensors will also need to be able to speak to one another to track and gather intelligence on adversary assets and maneuvers in the region.[41] This will require better data sharing across domains and between the military services—in line with the Joint All Domain Operations concept and plans for a Joint All Domain Command and Control (JADC2) system.[42]
- **Emphasize nuclear safety.** Reports that Russia has recently conducted nuclear weapons-related tests off the Novaya Zemlya Islands, its decision to launch a nuclear power station in the region and the recent nuclear-propelled missile accident have highlighted the growing risks of nuclear accidents in the region. As a result, the United States should consider conducting nuclear accident exercises with Arctic states and allies neighboring the Arctic. Doing so would have the benefit of ensuring better preparedness to manage a nuclear accident while also drawing attention to Russia's questionable nuclear activities in the region. U.S. efforts to clean up radioactive waste from the Fukushima Daiichi power station in the aftermath of the 2011 Great East Japan Earthquake—known as Operation Tomodachi—provided valuable experience to the U.S. military in effective response to nuclear accidents, including rapid coordination with U.S.

partners, deploying personnel to rescue survivors, and cleanup of debris in affected areas in a timely manner, which could be leveraged for the Arctic region.[43]

Specifically, the United States (and the Coast Guard, Air Force, and Space Force) should work with Arctic partners to prepare and exercise for potential future nuclear emergencies, building upon existing multilateral organizations focused on nuclear safety, such as the IAEA and OECD Nuclear Energy Agency (NEA), to which all eight Arctic states already claim membership. Enhanced readiness would begin with an assessment of how disaster relief assets and personnel can be rapidly mobilized into the region and be advanced by exercising with Arctic partners to gain experience in this challenging operational environment. Russia should be invited to participate in these exercises—as an Arctic state, Russia has an interest in promoting nuclear safety in its backyard. In the event it declines, the United States could use that refusal to further highlight Russian irresponsibility in the region. ■

Rebecca Hersman *is director of the Project on Nuclear Issues (PONI), and a senior adviser for the International Security Program at the Center for Strategic and International Studies (CSIS) in Washington, D.C.* ***Eric Brewer*** *is deputy director and senior fellow with PONI at CSIS.* ***Maxwell Simon*** *is a program coordinator and research assistant with PONI at CSIS.*

Nothing in this briefing should be understood to convey the view or position of any U.S. government organization or its employees. Nor does it imply the endorsement of the contents of the report by any government organization or its employees.

This research was made possible through the generous support of the Defense Threat Reduction Agency.

CSIS BRIEFS are produced by the Center for Strategic and International Studies (CSIS), a private, tax-exempt institution focusing on international public policy issues. Its research is nonpartisan and nonproprietary. CSIS does not take specific policy positions. Accordingly, all views, positions, and conclusions expressed in this publication should be understood to be solely those of the author(s). *© 2021 by the Center for Strategic and International Studies. All rights reserved.*

Cover Photo: U.S. Pacific Fleet/Flickr (CC BY-NC 2.0)

ENDNOTES

1 Ariel Cohen, Jim Dolbow, and Lajos F. Szaszdi, *The New Cold War: Reviving the U.S. Presence in the Arctic* (Washington, DC: The Heritage Foundation, October 2008), https://www.heritage.org/environment/report/the-new-cold-war-reviving-the-us-presence-the-arctic.

2 Maxim Starchak, "The Borei-A SSBN: How Effective Is Russia's New Nuclear Submarine?," Jamestown Foundation, Eurasia Daily Monitor, June 16, 2020, https://jamestown.org/program/the-borei-a-ssbn-how-effective-is-russias-new-nuclear-submarine/.

3 Barbara Barrett, *The Department of the Air Force Arctic Strategy* (Washington, DC: Department of the Air Force, July 2020), https://www.af.mil/Portals/1/documents/2020SAF/July/ArcticStrategy.pdf.

4 Congressional Research Service, *Changes in the Arctic: Background and Issues for Congress,* CRS Report No. R41153 (Washington, DC: August 2020), https://fas.org/sgp/crs/misc/R41153.pdf.

5 Paul McLeary, "Norway Expands Key Arctic Port For More US Nuke Sub Visits," Breaking Defense, September 3, 2020, https://breakingdefense.com/2020/09/norway-expands-key-arctic-port-for-more-us-nuke-sub-visits/.

6 "Arctic Sea Ice Minimum," NASA Global Climate Change: Vital Signs, January 15, 2020, https://climate.nasa.gov/vital-signs/arctic-sea-ice/.

7 Sandra Cassotta et al., "Polar Regions," in *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (Geneva: Intergovernmental Panel on Climate Change, 2019), https://www.ipcc.ch/srocc/chapter/chapter-3-2/.

8 Jan Hjort et al., "Degrading Permafrost Puts Arctic Infrastructure at Risk by Mid-Century," *Nature Communications 9*, no. 1 (December 2018): 5147, doi:10.1038/s41467-018-07557-4.

9 Department of Defense, *Report to Congress on Arctic Operations in the Northwest Passage* (Washington, DC: May 2011), https://dod.defense.gov/Portals/1/Documents/pubs/Tab_A_Arctic_Report_Public.pdf.

10 Zachariah Hughes, "How Climate Change Is Affecting Alaska's Military Radar Stations," NPR, February 25, 2019, https://www.npr.org/2019/02/25/697615977/how-climate-change-is-affecting-alaskas-military-radar-stations.

11 Eddy Bekkers, Joseph Francois, and Hugo Rojas-Romagosa, "Melting Ice Caps and Economic Impact of Opening the Northern Sea Route," Netherlands Bureau for Economic Policy Analysis, CPB Discussion Paper, May 2015, https://www.cpb.nl/sites/default/files/publicaties/download/cpb-discussion-paper-307-melting-ice-caps-and-economic-impact-opening-northern-sea-route.pdf.

12 Mathieu Boulègue, *Russia's Military Posture in the Arctic: Managing Hard Power in a "Low Tension" Environment* (London: Chatham House, 2019), https://www.chathamhouse.org/sites/default/files/2019-06-28-Russia-Military-Arctic_0.pdf.

13 Rebecca Hersman, *The Deterrence and Assurance Conversation* (Washington, DC: CSIS, January 13, 2017), https://www.csis.org/analysis/deterrence-and-assurance-conversation.

14 Boulègue, *Russia's Military Posture in the Arctic*.

15 Jørgen Staun and Forsvarsakademiet (Denmark), *Russia's Strategy in the Arctic* (Copenhagen: 2015), http://www.fak.dk/publikationer/Documents/Russias%20Strategy%20in%20the%20Arctic.pdf; Boulègue, *Russia's Military Posture in the Arctic*; and Matthew Melino, Heather A. Conley, and Joseph S. Bermudez Jr., *The Ice Curtain: Modernization on the Kola Peninsula* (Washington DC: CSIS, March 2020), https://www.csis.org/analysis/ice-curtain-modernization-kola-peninsula.

16 James Lacey, "Battle of the Bastions," War on the Rocks, January 9, 2020, https://warontherocks.com/2020/01/battle-of-the-bastions/.

17 Ibid.

18 Heather Conley and Matthew Melino, *America's Arctic Moment: Great Power Competition in the Arctic to 2050* (Washington, DC: CSIS, March 2020), https://www.csis.org/analysis/americas-arctic-moment-great-power-competition-arctic-2050; and Matthew Melino and Heather Conley, "The Ice Curtain: Russia's Military Presence in the Arctic," CSIS, March 26, 2020, https://www.csis.org/features/ice-curtain-russias-arctic-military-presence.

19 Thomas Nilsen, "Putin Heightens the Strategic Role of the Northern Fleet," Barents Observer, June 8, 2020, https://thebarentsobserver.com/en/security/2020/06/putin-heightens-strategic-role-northern-fleet.

20 Conley and Melino, *America's Arctic Moment*.

21 The RS-24 Yars has an estimated range of 10,500 km and is capable of carrying multiple thermonuclear warheads; Melino, Conley, and Bermudez Jr., *The Ice Curtain*.

22 Ibid.

23 Thomas Nilsen, "Bulava Ballistic Missile Launch from Brand New Strategic Sub in White Sea," Barents Observer, October 30, 2019, https://thebarentsobserver.com/en/security/2019/10/bulava-ballistic-missile-launch-brand-new-strategic-sub-white-sea.

24 Public information suggests Russia currently plans for 10 Borei-class SSBNs as part of its project 955 and 955A, though Russian state media has suggested the ultimate goal may be as high as 14. Amy Woolf, *Russia's Nuclear Weapons: Doctrine, Forces, and Modernization*, CRS Report No. R45861 (Washington, DC: Congressional Research Service, July 2020), https://fas.org/sgp/crs/nuke/R45861.pdf; and Martin Manaranche, "Russian Navy Likely To Have 12 Borei-Class SSBN," TASS Russian News Agency, April 27, 2020.

25 Manaranche, "Russian Navy Likely To Have 12 Borei-Class SSBN."

26 Nilsen, "Bulava Ballistic Missile Launch from Brand New Strategic Sub in White Sea."

27 Dannreuther, Roland. "China and Global Oil: Vulnerability and Opportunity." *International Affairs (Royal Institute of International Affairs 1944-)* 87, no. 6 (2011): 1345-364, http://www.jstor.org/stable/41306994.

28 Melino, Conley, and Bermudez Jr., *The Ice Curtain.*

29 Mark Rosen and Cara Thuringer, *Unconstrained Foreign Direct Investment: An Emerging Challenge to Arctic Security* (Arlington, VA: CNA Corporation, November 2017), https://www.cna.org/cna_files/pdf/COP-2017-U-015944-1Rev.pdf.

30 Keith Bradsher, "Amid Tension, China Blocks Vital Exports to Japan," *New York Times*, September 22, 2010, https://nytimes.com/2010/09/23/business/global/23rare.html.

31 Marco Volpe, "The Tortuous Path of China's Win-Win Strategy in Greenland," Arctic Institute, March 24, 2020, https://www.thearcticinstitute.org/tortuous-path-china-win-win-strategy-greenland/.

32 Ernie Regehr, *Replacing the North Warning System: Strategic competition or Arctic confidence building?* (Vancouver: The Simons Foundation, March 1, 2018), http://www.thesimonsfoundation.ca/highlights/replacing-north-warning-system-strategic-competition-or-arctic-confidence-building.

33 Barrett, *The Department of the Air Force Arctic Strategy.*

34 George Soroka, "Putin's Arctic Ambitions," *Foreign Affairs*, May 5, 2016, https://www.foreignaffairs.com/articles/russia-fsu/2016-05-05/putins-arctic-ambitions; Thad Allen, Christine Todd Whitman, and Esther Brimmer, *Arctic Imperatives: Reinforcing U.S. Strategy on America's Fourth Coast* (Washington, DC: Council on Foreign Relations, 2017), https://www.cfr.org/content/publications/attachments/TFR75_Arctic.pdf; and Dezan Shira & Associates, "Russian Arctic Annual GDP to Reach US$500 Billion," Russia Briefing (blog), March 29, 2019, https://www.russia-briefing.com/news/russian-arctic-annual-gdp-reach-us-500-billion.html/.

35 David Brennan, "Russia Is Testing Nuclear Weapons at Remote Arctic Bases despite Global Ban, U.S. Claims," *Newsweek*, May 30, 2019, https://www.newsweek.com/russia-nuclear-weapons-testing-arctic-us-claims-low-yield-ban-1439109.

36 David E. Sanger and Andrew E. Kramer, "U.S. Officials Suspect New Nuclear Missile in Explosion That Killed 7 Russians," *New York Times*, August 12, 2019, https://www.nytimes.com/2019/08/12/world/europe/russia-nuclear-accident-putin.html.

37 Congressional Research Service, *Coast Guard Polar Security Cutter (Polar Icebreaker) Program: Background and Issues for Congress,* CRS Report No. RL34391 (Washington, DC: December 2018), https://crsreports.congress.gov/product/pdf/RL/RL34391/167.

38 Congressional Research Service, *Coast Guard Polar Security Cutter (Polar Icebreaker) Program*; and Donald Trump, "Memorandum on Safeguarding U.S. National Interests in the Arctic and Antarctic Regions," The White House, June 9, 2020, https://www.whitehouse.gov/presidential-actions/memorandum-safeguarding-u-s-national-interests-arctic-antarctic-regions/.

39 Barret, *The Department of the Air Force Arctic Strategy.*

40 Vivienne Machi, "United States, Canada Studying Options to Replace Arctic Early Warning Radars," *National Defense Magazine*, July 27, 2018, https://www.nationaldefensemagazine.org/articles/2018/7/27/united-states-canada-studying-options-to-replace-arctic-early-warning-radars.

41 Andrea Charron, "Beyond the North Warning System," War on the Rocks, September 7, 2020, https://warontherocks.com/2020/09/beyond-the-north-warning-system/.

42 Congressional Research Service, *Joint All Domain Command and Control* (JADC2), CRS Report No. IF11493 (Washington, DC: September 28, 2020), https://fas.org/sgp/crs/natsec/IF11493.pdf.

43 Richard Samuels, 3.11: *Disaster and Change in Japan* (Cornell University Press, 2013), https://www.jstor.org/stable/10.7591/j.ctt1xx5k4.