



A Race for Nuclear-Powered Submarines on the Korean Peninsula?

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North Korea's development of nuclear-powered ballistic missile submarines would enhance its nuclear deterrent capability, making preemptive strikes against the country risky. South Korea has also declared its intention to develop nuclear-powered submarines to enhance its anti-submarine capability. While it is questionable whether either plan will materialize, as both countries face their own obstacles, the race for nuclear-powered submarines could heighten the insecurity on the Korean Peninsula. This essay will examine each country's plans and assess the implications for regional security.

North Korea

The Democratic People's Republic of Korea (DPRK), or North Korea, is advancing its capacity to launch ballistic missiles from submarines. The DPRK successfully tested its first submarine-launched ballistic missile (SLBM), Pukkuksong-1, in August 2016, which flew approximately 300 miles toward Japan. In October 2019, North Korea tested another SLBM, Pukkuksong-3, that flew 565 miles, also toward Japan. During a military parade that commemorated the 8th Congress of the Workers' Party of Korea in January 2021, Pyongyang displayed a new type of SLBM, the Pukkuksong-5. The total length of the missile is the same as the Pukkuksong-4, displayed

in October 2020, but longer in the warhead area, which may indicate the missile's ability to carry multiple warheads.¹ SLBMs, in particular those carrying multiple warheads, are hard to intercept with missile defense systems. While it is unclear whether the newest missile has reached operational status, if the missile does carry multiple warheads, it would enhance North Korea's second-strike capability (i.e., the ability to survive preemptive nuclear strikes).

As part of its efforts to enhance its capability to launch ballistic missiles from submarines without detection, the DPRK is pursuing the development of nuclear-powered ballistic missile submarines, classified as "SSBNs" in the U.S. Navy (SS for subsurface, B for ballistic missile, and N for nuclear propulsion). Although North Korea has one of the world's largest

¹ Mitch Shin, "North Korea Holds Nighttime Military Parade after Party Congress," *Diplomat*, January 15, 2021, <https://thediplomat.com/2021/01/north-korea-holds-nighttime-military-parade-after-party-congress>.

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submarine fleets, all of its 60 to 80 submarines use diesel-electric propulsion engines. The August 2016 SLBM test was fired from a 2,000-ton Gorae-class diesel-electric ballistic missile submarine. On January 9, 2021, during the Party Congress, the state-run Korean Central News Agency reported that Kim Jong-un had announced a plan to develop cutting-edge military assets, including nuclear-powered submarines, multiple-warhead guidance technology, unmanned aerial vehicles, military reconnaissance satellites, and hypersonic missiles.² Kim said that design research for nuclear-powered submarines had already been completed, and the design was in the final review process.

Theoretically, North Korea's development of SSBNs could be a game changer. SSBNs would enhance the DPRK's second-strike capability by increasing the odds that its sea-based nuclear missiles would survive even if its land-based missiles were neutralized. This is because nuclear-powered submarines do not require constant refueling like diesel-electric submarines, and thus can stay underwater for a long time (almost indefinitely if fueled by highly enriched uranium, which the DPRK possesses). This reduces the risk of detection. Moreover, they are around three times as fast as diesel-electric submarines.³

In addition, SSBNs may give North Korea the capability to launch a nuclear strike against the U.S. mainland, which has heretofore eluded the country. Although the DPRK has successfully tested intercontinental ballistic missiles (ICBMs) that can reach the U.S. mainland, it has not successfully tested a re-entry vehicle that protects nuclear warheads from the intense heat and vibration generated when ICBMs re-enter the atmosphere. North Korea's SSBNs would, in theory, overcome this limitation by launching

missiles closer to the U.S. mainland. If the United States cannot ascertain that all of North Korea's SSBNs have been accounted for, a preemptive attack against the DPRK, such as the "bloody nose" option contemplated by President Donald Trump, would be too risky.

In reality, however, the effectiveness of North Korean SSBNs as a strategic deterrent is dubious because advanced technology would be required to reduce the vessels' acoustic signatures. Early Soviet SSBNs, for example, were too noisy to provide credible deterrence, as are India's SSBNs today. Chinese SSBNs only recently have made advances in this area, several decades after the country's first SSBN was constructed. Consequently, there is a low chance that the DPRK could soon build SSBNs quiet enough to avoid detection, let alone stealthily approach the U.S. mainland.

Moreover, ensuring a second-strike capability will require establishing and protecting reliable command, control, and communications (C3). During the Cold War, Soviet submarines' authority to use nuclear weapons resided with Moscow. The country's SLBMs contained electro-mechanical "locks" that required an "unlock" code from the Soviet Naval Command to launch.⁴ If strikes against Soviet C3 had severed communications between Moscow and SSBNs, nuclear missiles on those submarines would have been rendered useless. The C3 would likely be similar in the case of North Korea. Given that North Korea has declared that only Kim Jong-un can order a nuclear strike,⁵ it is unlikely to delegate authority to use nuclear weapons to SSBN crews when such a move would trigger retaliation from the United States. Just like Soviet-era SSBNs, a first strike against North Korea's C3 could render the country's SLBMs

² Joshua Berlinger and Yoonjung Seo, "Kim Jong Un Says North Korea Is Developing Tactical Nukes, New Warheads and a Nuclear-Powered Submarine," CNN, January 9, 2021, <https://www.cnn.com/2021/01/09/asia/north-korea-nuclear-development-intl-hnk/index.html>.

³ Hans J. Ohff, "Nuclear Versus Diesel-Electric: The Case for Conventional Submarines for the RAN," Australian Strategic Policy Institute, June 11, 2017, <https://www.aspistrategist.org.au/nuclear-versus-diesel-electric-case-conventional-submarines-ran>.

⁴ Robert D. Glasser, "Enduring Misconceptions of Strategic Stability: The Role of Nuclear Missile-Carrying Submarines," *Journal of Peace Research* 29, no. 1 (1992): 23–37.

⁵ Vipin Narang and Ankit Panda, "Thinking Through Nuclear Command and Control in North Korea," *Diplomat*, September 16, 2017, <https://thediplomat.com/2017/09/thinking-through-nuclear-command-and-control-in-north-korea>.

useless and negate their second-strike capability. It is questionable whether North Korea can even acquire reliable C3 supported by a sophisticated satellite system that would provide effective communications between Pyongyang and SSBNs.

Additionally, the DPRK's ambition is unlikely to be realized in the near future because building SSBNs requires sophisticated technology and enormous financial investment. It is harder to build nuclear power plants than to produce nuclear weapons, and even harder still to make small naval reactors. North Korea has limited experience with nuclear power generation, illustrated by its request for U.S. assistance in constructing two light-water reactors in return for abandoning the Yongbyon reprocessing facility in the 1994 Agreed Framework. Although North Korea has developed nuclear weapons and ballistic missiles since then, which is a remarkable technical feat, this was made possible partially by external assistance, including from Pakistan's A.Q. Khan network. Only six countries (the permanent members of the UN Security Council plus India) currently have nuclear-powered submarines, though Japan and Germany built but have since decommissioned them. This makes it hard to acquire external assistance for developing SSBNs as North Korea did for nuclear weapons. Without that option, indigenous development of SSBNs would be a lengthy process. India, which began its civil nuclear energy program in the 1950s and its pursuit of nuclear propulsion in the 1960s with the assistance of the Soviet Union, only commissioned its first nuclear-powered submarine, the INS *Arihant*, in 2016.

Another obstacle is that SSBNs are expensive. India's Arihant-class submarines were built at a cost of \$2.9 billion per submarine, almost one-tenth of North Korea's 2019 GDP (\$32 billion).⁶ This cost would seem exorbitant for North Korea, especially since multiple submarines would be required to ensure a second-strike

capability. (A single submarine could be tracked and destroyed when resurfacing for maintenance, for example.) In light of the dire economic hardship that the DPRK currently faces—its GDP is estimated to have decreased by 8.5% in 2020 from the previous year—the country would appear financially incapable of developing SSBNs at present.⁷

South Korea

The technical and financial limitations analyzed in the previous section suggest that the DPRK's declaration of its pursuit of nuclear-powered submarines is aimed at strengthening its bargaining power vis-à-vis the United States and enhancing domestic legitimacy rather than articulating a realistic goal. Nonetheless, the Republic of Korea (ROK), or South Korea, is responding by pursuing its own nuclear-powered submarines, classified as "SSN" in the U.S. Navy (because they do not carry nuclear-tipped ballistic weapons). President Moon Jae-in advocated the development of nuclear-powered submarines to counter North Korea's SLBM capacity on the campaign trail in 2017 and has actively pursued SSN capabilities since taking office. However, this project was seemingly shelved after the PyeongChang Winter Olympics unification flag and the historic summits that followed ushered in a period of détente between the two Koreas. Still, even while the denuclearization negotiations were ongoing, the ROK Navy operated a task force on the construction of nuclear-powered submarines and conducted a feasibility study.

With the denuclearization negotiations with the North now all but dead, the Moon administration is reinvigorating its ambition for nuclear-powered submarines. In July 2020, Kim Hyun-chong, second deputy director of the National Security Office, stated that "the next-generation submarine will be equipped

⁶ Christina Zhao, "India \$2.9 Billion Nuclear Ballistic Missile Submarine Flooded and Almost Sank after Someone Left the Hatch Open," *Newsweek*, January 11, 2018, <https://www.newsweek.com/indian-india-nuclear-submarine-ballistic-missile-sank-hatch-left-open-777804>; and "Gross Domestic Product Estimates for North Korea in 2019," Bank of Korea, July 31, 2020, <https://www.bok.or.kr/eng/bbs/E0000634/view.do?nttId=10059560&menuNo=400069>.

⁷ Sam Kim, "North Korea Seeks Economic Boost amid Covid, Sanctions Pain," *Bloomberg*, December 29, 2020, <https://www.bloomberg.com/news/articles/2020-12-29/north-korea-eyes-new-economic-plan-as-covid-adds-to-sanction-hit>.

with an engine that uses nuclear fuel.”⁸ In August 2020, the ROK Ministry of National Defense issued the “2021–2025 Mid-term Defense Plan,” which revealed the goal to construct three 4,000-ton submarines, widely speculated to be nuclear-powered.⁹ In January 2021, the Agency for Defense Development and the Defense Acquisition and Program Administration proposed nuclear-powered unmanned nuclear depot ships, which run on low-enriched uranium.

Unlike North Korea, South Korea seems to already have the technical capacity to build nuclear-powered submarines. It enjoys an advanced shipbuilding capacity and submarine technology, as well as a large-scale nuclear energy program as the world’s fifth-largest nuclear energy producer. South Korea is also developing homegrown small modular reactor technology, which can be used for naval reactors.

However, it is hard to define a strategic rationale for the ROK to acquire nuclear-powered submarines. It already possesses advanced counter-SSBN capabilities. Its Chang Bogo Type-209 submarines and more advanced Son Won-il Type-214 submarines can travel fast, fire torpedoes (as well as anti-ship missiles in the case of the latter), and remain submerged for around 50 days without surfacing. In the Rim of the Pacific (RIMPAC) exercise, the world’s largest international maritime exercise, South Korea’s existing submarines have demonstrated their capacity to successfully detect and destroy nuclear-powered submarines, including the most advanced U.S. Ohio-class SSBNs.

In fact, to counter nuclear-powered submarines, small, nimble, and quiet diesel-electric submarines with an air-independent-propulsion system, such as South Korea’s Type-214 submarines, could be more effective than nuclear-powered submarines. Diesel-electric submarines can switch to battery power when submerged underwater, while SSBNs cannot turn off

their nuclear reactors, thus generating more noise. Japan’s diesel-electric submarines can detect China’s nuclear-powered submarines, but not the other way around, according to Chun Yong-woo, former national security adviser to President Lee Myung-bak.¹⁰ In addition, with the advancement of battery technology, diesel-electric submarines are expected to become faster and stay underwater for a longer period of time. South Korea’s existing submarines are thus better suited to counter North Korea’s SSBNs.

While nuclear-powered submarines would still add to South Korea’s naval strength, construction costs would be high. According to the ROK Navy, the cost of constructing one nuclear-powered submarine is estimated at \$1.2 to \$1.4 billion dollars, which is several times that of diesel-electric submarines.¹¹ Son Won-il Type-214 submarines cost only around \$330 million, in comparison. Zachary Keck and Henry Sokolski estimate that South Korea’s prospective nuclear submarines would cost around \$2.5 billion per unit, excluding the costs for research and development.¹²

The diplomatic costs of South Korea’s pursuit of nuclear-powered submarines may be even more substantial. To fuel these submarines, South Korea would need to either import enriched uranium or enrich uranium on its own. The United States has already rejected Seoul’s request for low-enriched uranium to fuel nuclear-powered submarines pursuant to U.S. domestic law that bans exports of nuclear materials for military purposes. Other nuclear suppliers would likely have similar trepidation about providing nuclear fuels used for military purposes. Alternatively, South Korea has the option of enriching uranium itself. Under the U.S.-ROK nuclear cooperation agreement,

⁸ Park Byong-su, “S. Korea Proposes Plans for Nuclear Submarine, Backpedals after Stirring Up Controversy,” *Hankyoreh*, January 21, 2021, http://english.hani.co.kr/arti/english_edition/e_national/979849.html.

⁹ “In-Depth Analysis Needed to Decide Development of Nuke-Powered Submarine: Seoul Ministry,” U.S. Nuclear Corp News, January 11, 2021, <https://usnuclearnews.com/in-depth-analysis-needed-to-decide-development-of-nuke-powered-submarine-seoul-ministry>.

¹⁰ Bak Yonghan, “Uriga meonbadae hamjeong bonael Il manna... gyeonghangmo haekjam doip nonran” [Should We Frequently Deploy the Fleet in Distant Seas? Controversy about the Introduction of Light Aircraft Carriers and Nuclear-Powered Submarines], *JoongAng Ilbo*, August 10, 2020, <https://news.joins.com/article/23845345>.

¹¹ Jeong Chungsin, “Haegun ‘haekjamsuham doip geomto TF unyongjung’ [The South Korean Navy Says “a Task Force to Examine Procuring Nuclear-Powered Submarines Is Ongoing”], *Munhwa Ilbo*, October 10, 2019, <http://www.munhwa.com/news/view.html?no=2019101001070630114001>.

¹² Zachary Keck and Henry Sokolski, “South Korea Is about to Make a \$7 Billion Nuclear Submarine Blunder,” *National Interest*, September 30, 2017, <https://nationalinterest.org/blog/the-buzz/south-korea-about-make-7-billion-nuclear-submarine-blunder-22540>.

also known as the 123 Agreement, South Korea can enrich uranium up to 20% with U.S. consent, but only for civilian purposes. Violation of the agreement would not only lead to the suspension of the United States' nuclear fuel supply for South Korea and the disruption of electricity generation. It would also damage the ROK's alliance with the United States, the primary pillar of its national security.

Further, taking this route would raise an alarm about South Korea's potential pursuit of nuclear weapons, damaging the country's reputation as a responsible upholder of nonproliferation norms. Although South Korea has announced that it would use low-enriched uranium to fuel its nuclear-powered submarines, taking the next step toward producing weapons-grade, highly enriched uranium would prove relatively easy once it acquires enrichment capacity. Thus, Seoul's ambition for nuclear-powered submarines raises the suspicion that its real motive may be "nuclear hedging," or maintaining the capability to develop nuclear weapons in short order.¹³ The fact that South Korea first pursued nuclear-powered submarines in 2003 under President Roh Moo-hyun, who pushed for a "self-reliant" national defense, and long before North Korea acquired SLBM capabilities, only adds to these suspicions.

Whatever Seoul's real motives, its pursuit of nuclear-powered submarines would heighten insecurity on the Korean Peninsula. Any suspicion of South Korean nuclear hedging would jeopardize hopes of convincing North Korea to denuclearize. Pyongyang vehemently protested when Seoul asked

the United States to supply nuclear fuels for South Korea's nuclear-powered submarines last year. North Korean state media characterized the request as an "extremely dangerous move that destroys peace on the Korean Peninsula, heightens tension in the region, and triggers an arms race."¹⁴ If North Korea's denuclearization remains an important goal for Seoul, development of nuclear-powered submarines would be counterproductive.

Conclusion

If North Korea were to successfully develop SSBNs, they could enhance its nuclear deterrent capability. However, it is unlikely that the DPRK will overcome the technical and financial barriers to acquire SSBNs in the foreseeable future. Even if North Korea did acquire SSBNs, their effectiveness as a strategic deterrent would remain questionable because the country lacks reliable command, control, and communications.

Meanwhile, South Korea's existing diesel-electric submarines are already capable of countering threats posed by North Korea's SSBNs. Against this backdrop, the pursuit of nuclear-powered submarines would provide only marginal security benefits, while damaging the ROK's alliance with the United States and reputation in the international community. Seoul must assess North Korean threats and effectively counter them. However, overreacting to the threat posed by North Korean SSBNs, or overestimating the benefits of constructing its own nuclear submarines, would undermine, rather than enhance, South Korean national security. ∞

¹³ Lami Kim, "South Korea's Nuclear Hedging?" *Washington Quarterly* 41, no. 1 (2018): 115–33.

¹⁴ Jeong Hyeonyong, "ICBM gonggaehan Byuk, Namhanen 'haegyeonryo paradalla gugeolhaessda' Binan" [As North Korea Unveils ICBMs, It Accuses South Korea of "Begging for Nuclear Fuel"], *Seoul Sinmun*, October 18, 2020, https://www.seoul.co.kr/news/newsView.php?id=20201018500006&wlog_tag3=naver.

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