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REDUCING THE RISK OF NUCLEAR WEAPON USE IN NORTHEAST ASIA

PROSPECTS FOR DPRK'S NUCLEAR USE SCENARIOS AND DETERRENCE MEASURES OF THE US AND ROK ALLIANCE

LEE SANGKYU

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ABOUT THE AUTHOR

Lee Sangkyu is an army officer for the Republic of Korea (ROK) and assistant professor at the Korea Military Academy (KMA). His main research focus is the Democratic People's Republic of Korea's (DPRK) nuclear threats, including its nuclear capabilities, strategies, and command and control system. Professor Lee holds PhD and MS degrees in Nuclear Engineering from the University of Utah in the United States. He has been an assistant professor in the Department of Physics at KMA since 2019, and from 2017 to 2018 served as the Nuclear Policy Planning Officer at the North Korea Policy Bureau, Ministry of National Defense, Republic of Korea.

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Please direct inquiries to:

Asia-Pacific Leadership Network
APLN Secretariat
4th fl., 116 Pirundae-ro
Jongno-gu, Seoul, ROK, 03035
Tel. +82-2-2135-2170
Fax. +82-70-4015-0708
Email. apln@apln.network

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Lee Sangkyu
Korea Military Academy

Reducing the Risk of Nuclear Weapon Use in Northeast Asia

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ABSTRACT

The purpose of this paper is to develop cases for the DPRK's use of nuclear weapons. As background, firstly, the deterrence and countermeasure strategies of the United States-ROK alliance in the face of the increasingly sophisticated DPRK's nuclear threat is examined. Then, the DPRK's nuclear capabilities and nuclear strategy are investigated, and nuclear use cases are presented in detail based on those strategies. The relative priorities and feasibility of the different DPRK nuclear use cases were analyzed using parameters evaluating their military effect, the potential for US nuclear retaliation, and the level of civilian casualties. Among the expected cases, an attack on the ROK Mobile Corps would seem to be the most probable scenario, since the benefits that the DPRK would gain from such an attack would be high. Within that case, there is a danger of nuclear provocation due to the asymmetry between the DPRK's nuclear possession and ROK's possession of only conventional forces. The importance of the US extended deterrence policy to deter the DPRK's nuclear threat is therefore emphasized, and measures to strengthen the credibility of US extended deterrence are also suggested.

Keywords: DPRK, Nuclear Capabilities, Nuclear Strategy, Nuclear Use Cases, US-ROK Alliance

I. INTRODUCTION (THE US-ROK STRATEGY)

The Republic of Korea (ROK) military has strengthened the US-ROK combined capabilities and posture with the United States, as well as its own capabilities and posture, to effectively deter and respond to the Democratic People's Republic of Korea (DPRK)'s nuclear and missile threats. First, the US-ROK alliance has improved its combined deterrence and response measures based on a joint "Tailored Deterrence Strategy (TDS)," implemented since 2016.[1] The TDS is a bilateral deterrence and response strategy designed for the situation on the Korean Peninsula in consideration of the characteristics of the DPRK's leadership and nuclear and missile threats, and it is a deterrence and response strategy that is one step more advanced than the general extended deterrence concept provided by the United States. The TDS strategy includes military and non-military countermeasures that include actions in the military, diplomatic, information, and economic domains. As such, TDS can be implemented in the full range of crisis scenarios, from the stage in which the DPRK threatens to use nuclear weapons to the stage in which nuclear weapons are actually used, as shown in Table 1.[2]

Consequently, there is a powerful and understandable operational and strategic logic for procuring and maintaining these increasingly powerful conventional capabilities. This ensures that any future arms control initiatives, be they focused on nuclear or conventional capabilities, are unlikely to succeed due to the confluence of different conflictual or competitive relationships across the region. Initiatives to increase stability in one relationship through such measures could result in insecurity in another relationship, thereby ensuring that no party will willingly give up nuclear or conventional capabilities.

[1] *Yonhap News*, "Establishment of the ROK-US tailored deterrence strategy and operational concept," January 7, 2016.
[2] ROK Ministry of National Defense, *2020 Defense White Paper* (Seoul: Ministry of National Defense, 2016), 59.

TABLE 1: MAIN ELEMENTS OF THE TDS AT VARIOUS STAGES OF NUCLEAR WEAPONS THREAT AND USE BY THE DPRK[3]

North Korean Action	Alliance Response
Threats to use nuclear weapons	US nuclear forces (strategic bombers, nuclear submarines equipped with ballistic missiles) and conventional precision strike forces are deployed on or around the Korean Peninsula, and additional ballistic missile defense assets are deployed.
Nuclear use is imminent	Announcement of preemptive strike against DPRK's nuclear-tipped missile units with precision-guided weapons, preparations to strike DPRK's nuclear power with US nuclear weapons, and enhancement of readiness for the US nuclear posture.
Nuclear use	Implement decisive countermeasures by the US-ROK national leadership.

Under the TDS, the concept of responding to the DPRK's ballistic missile use is evolving based on the capabilities of the US-ROK alliance. It is called the "US-ROK Alliance Comprehensive Counter-Missile Strategy," which is also known as the "4D operational concept."[4] "Comprehensive" here means improving the ability to respond to ballistic missile threats in all areas of detection, disturbance, destruction, and defense (4D). The two countries first agreed on the 4D operational concept in 2014 and approved the implementation guidelines in 2015. The guidelines are being developed in detail in five areas of the alliance's decision-making, planning, command and control, exercise and training, and capability development. These deterrence and response strategies deployed by the US-ROK alliance have been systematized to be ready to respond to the DPRK's use of nuclear weapons, but US-ROK command and/or leadership are required to make a decision to respond to DPRK nuclear weapons use.

Since 2018, along with the alliance capabilities, the ROK armed force has built a "WMD Response System" consisting of a "strategic strike system" and the "Korean Air and Missile Defense (KAMD)" to provide independent ROK deterrence and response capabilities. Before development of the WMD Response System, the ROK had developed the "Triad system," which was made up of "Kill chain," "Korea Massive Punishment and Retaliation (KMPR)," and "KAMD."[5]

The Kill chain was a striking system with the ambition of being able to disable the DPRK's nuclear and missile operations systems, including its missiles, mobile missile

[3] *Yonhap news,* "The main contents of the three-step tailored deterrence strategy and comparison by strategy," September 9, 2016.

[4] ROK Ministry of National Defense, *2020 Defense White Paper* (Seoul: Ministry of National Defense, 2020), 60~61.

[5] ROK Ministry of National Defense, *2016 Defense White Paper* (Seoul: Ministry of National Defense, 2016), 58.

launchers, command and control systems, and relevant fixed installations. The main means of carrying out these strikes were ground, surface, and subsurface-launched ballistic and cruise missiles, and air-launched guided bombs and missiles, all targeted based on information provided by surveillance and reconnaissance capabilities. The KMPR was also a striking system that was to be implemented by directly targeting DPRK leadership, including its war headquarters, through deployment of missiles capable of simultaneous, massive-scale precision strikes, and special operations units.[6] It was focused on developing a new missile launch system using large-capacity, high-performance conventional-explosive warheads and special operations units. After 2018, as a replacement of the Kill chain and KMPR, the "strategic strike system" has been implemented as a deterrence strategy functioning by both denial and punishment to deter and counter a full range of asymmetric threats. The main means features of the strategic strike system are long-distance surveillance capabilities and precision strike capabilities.

The KAMD has been developed without major changes since before 2018. It is a multilayered missile defense system that consists of a detection system, a command-and-control system, and an interception system. The main interceptor missiles used are upgraded Patriot missiles, medium-range surface-to-air missiles (M-SAM), and long-range surface-to-air missiles (L-SAM). M-SAM and L-SAM are being developed with the ROK own technology. The intercept height of M-SAM is about 40km[7] and that of L-SAM is about 50~60km[8]. As such, KAMD is active responds to missile threats by constructing a multilayered missile defense system and developing a ROK version of an "Iron Dome" as well.[9]

[6]ROK Ministry of National Defense, *2016 Defense White Paper* (Seoul: Ministry of National Defense, 2016), 59~60.
[7]*Hankyoreh news*, "Succeeded in intercepting surface-to-air missiles under development in South Korea," March 18, 2016.
[8]*Donga ilbo news*, "Ballistic missile defense, L-SAM, to be prototyped by 2024," December 4, 2019.
[9]*Chosun ilbo news*, "Promoting domestic development of 'Korean-style iron dome' that catches North Korean long-range artillery... 2035 deployment," June 28, 2021.

II. THE DPRK'S NUCLEAR CAPABILITY

The DPRK's current and future nuclear capabilities were well presented at the DPRK 8th Party Congress held from January 5 to 12, 2021. DPRK Chairman Kim Jong-Un announced a summary report in four areas during the Congress; First, a review of the Party's work since the 7th Congress, second, the advancement toward building domestic socialist power, third, the progress of independent reunification and external relations, and fourth, the strengthening of the Party programs.[10] In the report, details on strengthening nuclear deterrence are presented for the following:

- Development of nuclear-powered submarines
- Improvement of the accuracy of the 15,000 km intercontinental ballistic missile (ICBM)
- Individual guidance technology for multiple warheads
- Development of ground and sea launch intercontinental ballistic missiles with solid-fuel engines
- Development of tactical nuclear weapons
- Production of very high yield nuclear warheads

As such, a lot of content about the augmentation of the DPRK's nuclear force was provided during the Congress. In particular, in the "achievements" session, it was stated that "the accumulated nuclear technology was further advanced, so nuclear weapons are miniaturized and standardized. Developed nuclear weapons can be implemented for tactical weaponization, and high yield hydrogen bombs were developed. On November 29, 2017, the Party Central Committee proudly declared to the world the national nuclear force, with the great success of the test launch of the intercontinental ballistic missile, Hwasong-15."[11]

In the "advancement toward building domestic socialist power" session of the Congress, it was mentioned that "We will develop tactical nuclear weapons that can be applied in a variety of ways according to the purpose of operational missions and targets in modern warfare by further advancing nuclear technology. By continuously pushing forward with the production of very high yield nuclear warheads, it is

[10] *Peacetimes*, "[8th Party Congress] Summary of business summary report (full text)," January 9, 2021.
[11] Ibid.

necessary to maintain initiative and thoroughly deter, control, and manage various military threats in the Korean Peninsula, which is inevitably accompanied by nuclear threats."[12]As such, the DPRK emphasized the current status of nuclear weapons and noted the tactical nuclear weapons and high-yield nuclear weapons to be developed in the future.

The main terms, mentioned in the above statements, are miniaturization, tactical weaponization, tactical nuclear weapon, high yield hydrogen bomb, and very high yield nuclear warhead. The use of terms in the DPRK's 8th Party Congress and other statements were analyzed based on the DPRK's level of nuclear technology. Thus, miniaturization means reducing the size and weight of nuclear warheads to be able to load them on missiles. Technically, doing so means reducing the diameter of the nuclear warhead to less than one meter so that it can be mounted on medium-range and short-range missiles and to reduce the explosive power to about ten kiloton or less. With that, the total mass of a warhead is lighter than a few hundred kilograms. Next, standardization means unifying the specifications and material types of various nuclear weapons components so that mass production is possible.

Tactical weaponization means using the nuclear warheads disclosed on March 9, 2016, (see Figure 1) with short-range missiles such as SCUD and KN-23·24 for tactical purposes. The KN-23, which was test-launched first in 2019, has a diameter of 0.95 m and a payload weight of about 500 kg, and the KN-24 is estimated to have a diameter of 0.7 to 0.85 m and a payload weight of 400 to 500 kg. Therefore, the hydrogen bomb unveiled in 2017 is limited in the degree that it can be loaded on missiles, and only the nuclear warhead unveiled in 2016 might be mounted on the KN-23 or KN-24.

[12]Ibid. The 8th Party Congress report includes the following messages of tactical weaponization and tactical nuclear weapons. In the second part of the report ("Current achievements"), it states "총결기간 이미 축적된 핵기술이 더욱 고도화되여 핵무기를 소형경량화, 규격화, 전술무기화하고 초대형수소탄개발이 완성되였으며", for which the English translation is "During the previous congress period, the nuclear technology that had already been accumulated was further advanced, so it was completed that making nuclear weapons smaller and lighter, standardized, and tactical weaponization, and the development of super-large hydrogen bombs." In the fourth part of the report ("Future plans"), it states "핵기술을 더욱 고도화하는 한편 핵무기의 소형경량화, 전술무기화를 보다 발전시켜 현대전에서 작전임무의 목적과 타격대상에 따라 각이한 수단으로 적용할수 있는 전술핵무기들을 개발하고 초대형핵탄두생산도 지속적으로 밀고나감으로써", for which the English translation is: "While further advancing nuclear technology, we will further develop miniaturization and tactical weaponization of nuclear weapons to develop tactical nuclear weapons that can be applied in various ways depending on the purpose of operational missions and targets in modern warfare, and continue to push forward the production of super-large nuclear warheads."

FIGURE 1. THE DPRK'S DEVELOPED NUCLEAR WARHEADS[13]

	
Nuclear warheads announced on Mar. 9, 2016.[14]	**Nuclear warheads announced on Sept. 3, 2017.[15]**
Warhead type: fission bomb, boosted fission bomb Diameter: about 0.6m Weight: about 400kg Yield: 10kt	Warhead type: hydrogen bomb Size: width 0.8m × length 1.3m Weight: about 700kg Yield: 50kt

* The above data are estimated based on ROK government announcements and media reports.

Tactical weaponization denotes tactical use of an existing nuclear warhead, on the other hand, creating a tactical nuclear weapon means developing new weapons. The size of the tactical nuclear warhead should be further reduced in size for mounting on a weapon that can be fired by a large multiple rocket launcher, such as the KN-25 short-range ballistic missile, or on long-range artillery such as 240mm or 170mm rounds. The reason that size reduction is needed is that the outer diameter of the KN-25 is about 0.6 m and the payload is about 300 to 400 kg,[16] so the previously developed fission bomb is too large to be loaded. Therefore, it is necessary for the DPRK to

[13]Lee, Sangkyu, "Possibility of DPRK's Tactical Nuclear Development and its implications in terms of Nuclear Strategy and Nuclear Command and Control," *Defense and Technology*, March 2021.
[14]*Hankook ilbo news*, "How far does Kim Jong-un's confidence in the miniaturization of nuclear warheads go?" March 9, 2016.
[15]*Hankook ilbo news*, "Kim Jong-un visits the nuclear weapons research center and unveils the nuclear warhead (hydrogen bomb) of the Hwasong-14," September 3, 2017. The yield shown is that included in official ROK government announcements, although there are other opinions about the probable yields of DPRK nuclear weapons.
[16] Missile Threat, CSIS Missile Defense Project, "Missiles of the World > North Korea > KN-25," last updated July 31, 2021, https://missilethreat.csis.org/missile/kn-25/

develop a new type of more miniaturized nuclear warhead for a tactical nuclear weapon. Considering the DPRK's technological level, it will be possible to develop tactical nuclear weapons that can be mounted on long-range artillery and short-range missiles within a few years.[17]

The high yield hydrogen bomb, which the DPRK tested in 2017, is expected to be mounted on ICBM-class missiles such as the Hwasong-15 and -16, as well as and SLBMs (submarine-launched ballistic missiles) such as Pukguksong. The mention of a very high-yield nuclear warhead means that a hydrogen bomb with explosive power improved to the hundreds of kilotons range is to be developed in the future and will be mounted on ICBMs and SLBMs as well. As such, the DPRK is expected to possess a variety of nuclear weapons that can be used in various situations within a few years.

III. DPRK'S NUCLEAR STRATEGY AND NUCLEAR USE SCENARIOS

It is necessary to review the DPRK's nuclear strategy to project cases under which it might use nuclear weapons. The DPRK's nuclear strategy is analyzed based on the DPRK's laws, military strategies, statements, and nuclear capabilities. To start with the conclusion, it is expected that the DPRK will choose an asymmetric escalation nuclear strategy, which is very offensive, to effectively deter the US-ROK alliance. The reason is that the DPRK is far inferior to the United States in terms of the level and quantity of nuclear weapons technology, and its conventional force is also lacking in many areas compared to the combined forces of the US-ROK alliance. Therefore, to make up for this inferiority, an offensive nuclear strategy will be inevitably used to induce the US-ROK alliance to take passive actions. Such coercion tactics are the best deterrence strategy for the DPRK to achieve a strategic balance with the US-ROK alliance.

A representative example of the DPRK's offensive nuclear strategy is not to adopt the principle of 'No-First-Use' of nuclear weapons. These details can be confirmed by looking at the relevant laws and the statements so far. According to the fifth paragraph of the 'Act on the Consolidation of the Status of a Self-Defense Nuclear Power State' announced in 2013, "The Democratic People's Republic of Korea does not use or threaten nuclear weapons against non-nuclear countries unless it engages in an offensive action against the DPRK in alliance with other hostile nuclear states."

[17] Tactical nuclear weapons developed by the DPRK may be "gun-type" weapons using U-235 as the DPRK's stocks of enriched uranium increase.

At first glance, the DPRK appears to be adopting the principle of "No-First-Use." However, it presents prerequisites and specifies the possibility of a nuclear attack on the ROK. With that in mind, Kim Jong-Un mentioned the possibility of a preemptive use of nuclear weapons during the test-firing of the Hwasong-10 missile on June 23, 2016, as follows: "We should continue to expand and strengthen our preemptive nuclear strike capabilities and continue to research and develop various strategic attack weapons."[18]

It was also announced at the 8th Party Congress that "the goal of advancing the nuclear preemptive and retaliatory strike capabilities was presented. The national defense force has risen to a level where it can preemptively suppress threats to hostile forces." As such, the DPRK has made several statements suggesting the possibility of a preemptive use of nuclear weapons. From the laws and official statements made public so far, it is evident that the DPRK is adopting a threatening and offensive nuclear strategy.

In addition, in the concept of the DPRK's military strategy, it is basically adopting offensive strategies such as 'bolt out of the blue warfare,' 'combination of regular and irregular warfare,' and 'lightning war.'[19] To effectively use this military strategy, an offensive and asymmetric nuclear strategy will be combined. The bolt out of the blue warfare strategy adopts a surprise attack by selection of the time, means, and place of the attack in order to seize the initiative. For this, most of the DPRK military forces are deployed south of the Pyongyang-to- Wonsan line, and a large number of long-range artillery units are deployed in the southern DPRK.[20] If some of these long-range artillery units were entrusted with tactical nuclear weapons, the threshold for using nuclear weapons would be lowered,[21] which would pose a direct threat to the US-ROK alliance. Accordingly, even in small-scale military conflicts such as local provocations, the crisis precipitated by such conflicts might be expected to escalate rapidly. The purpose of the DPRK's combination of regular and irregular warfare is to prevent the US-ROK alliance from replenishing their combat power and to exhaust the combat power present in the ROK at an early stage by simultaneously striking front and rear battlefields. In particular, the ROK must defend ports and airfields in the rear area where US reinforcements will come in as strongly as it defends the first front line.

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[18]*Hankoyreh*, "North Korea declares successful test launch of medium-long-range missile 'Hwasong-10,'" June 23, 2016.

[19]Kim Tae-hyun. "A Study on the Change of north Korean Military Strategy: Risk Management against Mismatch of Strategy," *Journal of Strategic Studies*, 22-2 (2015): 167-204.

[20]Unification Education Center, Ministry of Unification, 2018 Understanding North Korea (Seoul, 2017), pp. 97-99.

[21] Several studies have pointed out and are concerned about this possibility. An example is Hyeongpil Ham (2021), "North Korea's Evolving Nuclear Posture: Strategic Implications of Pyongyang's Tactical Nuclear Weapons Development," *KIDA* (in Korean), dated October 15, 2021, and available as https://www.kida.re.kr/frt/board/frtPolicyStudyBoardDetail.do?sidx=363&idx=1195&depth=4&lang=kr

Therefore, it can be expected that the DPRK will threaten or actually use nuclear weapons against major ports, airfields, and industrial facilities that produce military supplies for the purpose of weakening the operational continuity of the US-ROK alliance.

The effect of the DPRKs tactical nuclear weapons on its nuclear strategy is as follows. If the DPRK develops and deploys tactical nuclear weapons they will take a more offensive nuclear posture, including high-strength provocation and coercion, to change the status quo. For instance, they will use tactical nuclear weapons in all areas of strategic, tactical, and operational plans by combining the capabilities of these weapons with the DPRK's offensive military strategy. First of all, if the DPRK's internal unrest increases, the DPRK military may conduct high-intensity provocations using conventional weapons targeting the ROK. With that, there is a possibility of threatening by using tactical nuclear weapons as a means of deterrence in case of conventional provocations.[22] A typical example of this is Russia's annexation of Crimea in 2014. At the time, the Russian foreign minister threatened the deployment of tactical nuclear weapons, leading the conflict to an advantageous situation.[23]Along with that the use of tactical nuclear weapons as a means of deterrence, there is a possibility that a paradoxical situation of stability and instability may arise on the Korean Peninsula, in the same way that small-scale disputes between India and Pakistan using conventional arms have increased since Pakistan has possessed nuclear weapons. This may be a reason for major military targets, such as the ROK Mobile Corps, to be selected by the DPRK for tactical nuclear weapon attack.

In addition, the DPRK might use tactical nuclear weapons as a means of coercion to change the status quo, such as seizing the initiative in the Korean Peninsula and in reunification after securing nuclear deterrence against the United States with their strategic nuclear weapons. To do so, they will deploy short-range missiles and multiple rocket launchers equipped with nuclear warheads, and then they might threaten the use of nuclear weapons and limit the strategic options of the US-ROK alliance or use nuclear weapons in wartime to secure initiatives.

Based on this perception of the DPRK's nuclear strategy, several nuclear use cases were prepared as shown in Table 2. The cases were evaluated with regard to three parameters: military effect, US nuclear retaliation, and civilian casualties. Military effects and US nuclear retaliation were chosen with benefits versus costs in mind from a deterrence perspective. The attribute of avoiding US nuclear retaliation is scored

[22] If the DPRK perceives that the credibility of extended deterrence by the United States cannot be guaranteed, it may misjudge that the United States will not guarantee the use of nuclear weapons at a similar level (low yield) to those used by the DPRK on the Korean Peninsula, leading the DPRK to believe that it could use nuclear weapons without being attacked with nuclear weapons in return.
[23] *Ajou Economic Daily,* "Russian Foreign Minister Suggests 'Possibility of Tactical Nuclear Deployment in Crimea, Ukraine,'" December 16, 2014.

high when the likelihood of US nuclear retaliation is low. The reason for including civilian casualties in the analysis is because Kim Jong-Un would consider environmental and historical evaluations, as well as political, military, and diplomatic factors, directly related to civilian casualties in the process of his decision to use nuclear weapons. The cases were divided into direct nuclear use and nuclear use to produce EMP (electromagnetic pulse) effects. For direct nuclear targets, the ROK Mobile Corps, Jinhae Naval Base, and Seoul, where the Ministry of National Defense and Joint Chiefs of Staff are located, are selected. In addition, the US military base in Pyeongtaek is also selected.

For the EMP attack, the high seas near Wonsan, the DMZ, and Busan Port were selected. The priority of the attack cases was evaluated as shown in Table 2 based on the three parameters. In the evaluation, five points were the highest point rating and one point was the lowest rating for each parameter. The case deemed the most probable based on this analysis was a direct attack on the mobile corps, followed by an EMP attack at the DMZ, a direct attack on the Jinhae Naval Base, and an EMP attack at the port of Busan.

TABLE 2. THE DPRK'S POTENTIAL NUCLEAR USE CASES AND PRIORITIES

Targets		Military effect	Avoiding US Nuclear Retaliation	Minimizing Civilian Casualties	Overall Priority Rank (total score)
Direct Nuclear Use	ROK Mobile Corps	5	3	5	1 (13)
	Jinhae Naval Base	5	3	2	3 (10)
	Seoul	4	2	1	7 (7)
	Pyeongtaek (US military base)	5	1	2	6 (8)
EMP Attack	High seas near Wonsan	1	4	4	5 (9)
	DMZ	4	3	4	2 (11)
	Busan port	3	3	4	3 (10)

The four most probable cases are analyzed in detail as follows. The highest-rated case is that the ROK Army Mobile Corps would be attacked directly in the northern region of Gyeonggi-do with a nuclear weapon of 10-20 kt, although other weapons combinations and attack options are possible. The DPRK may intend to end the war early in an advantageous situation by disabling the main force of the ROK military forces and thus make ROK counter-attack operations impossible. It is expected that the nuclear attack will cause direct damage to personnel and equipment, and

consequent loss of combat power. In addition, northern Gyeonggi-do and parts of Gangwon-do will be contaminated with fallout.[24]

The second highest-rated case is designed to cause wide range damage from an EMP caused by a high-altitude nuclear explosion near the DMZ at the beginning of the war. If the DPRK detonates a 20 kt yield nuclear weapon at an altitude of 60 km using a ballistic missile such as the SCUD or KN-23, the surrounding region will be affected by an EMP to a radius of up to about 800 km from the location of the explosion.[25] Unfortunately, because of the direction of the geomagnetic field on the Korean Peninsula, a stronger EMP is created in the South than in North, thus the EMP would cause more damage in Seoul than North of the DMZ. In addition, in general, the ROK is more reliant on technologies that are vulnerable to EMPs than is the DPRK. The DPRK's intention might be to cause social chaos by neutralizing the national core infrastructure in Seoul, as well as to neutralize the command and communication system of the ROK military.[26]

In the 3rd and 4th-ranked cases, the attack targets are the Jinhae Naval Base and the port of Busan. Jinhae and Busan are geographically very close. These two cases differ depending on whether it is a direct nuclear attack or a situation in which only EMP is induced by detonating a nuclear weapon at an altitude of 50 km. In both cases, however, the DPRK's intended purpose might be similar, as follows. The purpose is to delay the deployment of the US mainland reinforcements and UN forces entering through major ports and to incapacitate the ROK's core national infrastructure, because Busan is the second largest city of the ROK. Through this, the DPRK will try to end the war prematurely by weakening the ROK's ability to sustain the war. As such, in these cases, the DPRK's use of nuclear weapons is not primarily to deter the offensive strategy of the United States and ROK, but rather because the DPRK perceives that the use of nuclear weapons will be effective from a warfighting standpoint.

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[24] This type of damage could occur with either ground burst or air burst weapons detonation, though not with high-altitude explosions. Depending on the height of the explosion, an air burst could also cause some fallout. Fallout would create a wider range of contaminated areas than the areas where the detonation would have direct lethal impacts.

[25] There are many studies and articles describing the potential for the DPRK to use nuclear weapons to create EMPs with high-altitude explosions. These include Peter Vincent Pry, *North Korea: EMP Threat, North Korea's Capabilities for Electromagnetic Pulse (EMP) Attack*, (US) EMP Task Force on National and Homeland Security, June 6, 2021, https://emptaskforce.us/wp-content/uploads/2021/06/REPORTempthreatNK21A.pdf; and Peter Vincent Pry, "North Korea EMP Attack: An Existential Threat Today," *The Cipher Brief*, August 22nd, 2019, https://www.thecipherbrief.com/column_article/north-korea-emp-attack-an-existential-threat-today

[26] See for example, Bruce Dorminey, "North Korean EMP Attack Would Cause Mass U.S. Starvation, Says Congressional Report," Forbes, October 23, 2017, https://www.forbes.com/sites/brucedorminey/2017/10/23/north-korea-emp-attack-would-cause-mass-u-s-starvation-says-congressional-report/?sh=16fe4c8e740a

Since all of the aforementioned DPRK's nuclear use cases are assumed to be used in the Korean Peninsula, short-range missiles will be used as a means of delivery. The DPRK has not yet declared the actual deployment of nuclear weapons, so it is unclear exactly which missiles will be equipped with nuclear warheads.[27] Based on the recently tested missiles with improved accuracy, however, some SRBMs can be expected to be equipped with a nuclear warhead of several tens of kilotons in the future, that is, by around 2030.

The SRBMs most likely to carry a nuclear warhead are the SCUD-MaRV (Maneuverable Reentry Vehicle), KN-23 and KN-24. The SCUD-MaRV is a SRBM with a range of 450 km and has distinctive forward fins, presumably to add a terminal guidance capability for increased maneuverability and accuracy.[28] It is estimated to be 13.5 m long and 0.88 m in diameter. It will therefore be sufficient to carry the fission bomb tested by the DPRK in 2016. The KN-23 has a length of 7.5 m, a diameter of 0.95 m, and a payload of 500 kg.[29] It was first tested in 2019 and has a range of about 690 km. It is characterized by its resemblance to the Russian Iskander-M, which can do the "pull-up" maneuver in its terminal phase of flight to lower the probability of interception.

The KN-24 is classified as a SRBM with a range of 410 km, but the DPRK has listed it as a missile that can be fired from a super-large multiple rocket launcher. Its appearance is similar to that of the US ATACMS (Army Tactical Missile System). The length of KN-24 is 4.57-5.55 m and the diameter is about 0.7-0.85 m.[30] The payload is estimated to be 400-500 kg, so it might carry a small nuclear warhead when used tactically.

In addition to short-range missiles, there is a possibility of using SLBMs such as the Pukguksong-3 to attack the rear area of the ROK, such as the Busan Port. The Pukguksong-3 has a range of 1,900 km[31] and is expected to be able to carry large warheads such as hydrogen bombs.

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[27] It has been suggested that it might be possible for the United States, through satellite surveillance, to identify nuclear missiles as the DPRK brings them out of storage for use. It is questionable, however, whether it is possible to completely distinguish between conventional warheads and nuclear warheads during transport.

[28]Missile Threat, CSIS Missile Defense Project, "Missiles of the World > North Korea > KN-18 (Scud MaRV)," last updated July 31, 2021, https://missilethreat.csis.org/missile/kn-18-marv-scud-variant/

[29]Missile Threat, CSIS Missile Defense Project, "Missiles of the World > North Korea > KN-23," last updated July 31, 2021, https://missilethreat.csis.org/missile/kn-23/

[30]Missile Threat, CSIS Missile Defense Project, "Missiles of the World > North Korea > KN-24," last updated January 18, 2022, https://missilethreat.csis.org/missile/kn-24/

[31]Missile Threat, CSIS Missile Defense Project, "Missiles of the World > North Korea > Pukguksong-3 (KN-26)," last updated July 31, 2021, https://missilethreat.csis.org/missile/pukguksong-3/

It should be emphasized that in considering these use cases, warfighting and deterrence need to be distinguished. The US Strategic Command, for example, has separate divisions for these two functions. The reason why weapons such as ICBMs and MIRVs (multiple independent reentry vehicles) were developed by the DPRK seems to be to secure deterrence against the United States. With such deterrence, the DPRK likely calculates that it could weaken the US extended deterrence and ultimately induce decoupling between the United States and the ROK. If the Unites States' extended deterrence is weakened, the possibility of the DPRK's use of nuclear weapons on the Korean Peninsula will increase further.

IV. DETERRANCE AND RESPONSE MEASURES AGAINST DPRK'S NUCLEAR USE

The DPRK's advanced nuclear capability and its offensive nuclear strategy are a great threat to the US-ROK alliance. Deterring these threats is not easy, and deterrence usually works when the provoking state feels that the costs outweigh the benefits. In the case of deterrence with conventional forces alone, however, the possibility of deterrence failure increases due to the asymmetry. Therefore, to effectively deter the DPRK's intention to use nuclear weapons, it is important to increase the credibility of the US extended deterrence policy. However, if there is doubt in the credibility of the extended deterrence, the deterrence effect will decrease, so there will be a risk that the DPRK's nuclear use cases will become reality.

The main challenges of the extended deterrence are known as "de Gaulle's Doubts," "A Leaky Umbrella," the "Healey Theorem," "Status Quo Ante,"[32] and "Putting the Cart before the Horse." First, "De Gaulle's doubt" originated from the question of Charles de Gaulle, a French general and president, during the Cold War, when he felt that the United States would not risk New York or Detroit to save Hamburg or Lyons.[33] By the same logic, there could be a question whether the United States would sacrifice its own cities like Los Angeles or San Francisco to defend Seoul. As the DPRK develops ICBMs capable of hitting the US mainland, these suspicions have grown. As such, it raises doubts about the ability to implement the nuclear umbrella and may eventually lead to decoupling of the ROK-US alliance. In addition, if the DPRK has

[32]Justin V. Anderson, Jeffrey A. Larsen, "Extended Deterrence and Allied Assurance: Key Concepts and Current Challenges for U.S. Policy," *INSS Occasional Paper,* USAF Academy, September 2013, 73-79.
[33]*New York Times*, "The De Gaulle Nuclear Doctrine is Alive in Paris," May 6, 1981.

the same suspicion that the United States may not be willing to keep its alliance commitments, there is a possibility that the DPRK perception of the situation may cause it to misjudge that the United States will not help the ROK, and that US deterrence will thus fail. Efforts are therefore required to resolve the so-called "De Gaulle's doubt" and increase the credibility of the US commitment to extended deterrence.

Second, the "Leaky Umbrella" challenge refers to the United States possibly not deploying sufficient military forces (conventional, nuclear, and missile defense) to prevent a potential adversary from targeting its allies, or may not be able to mount an adequate level of military response to a provocation.[34] Therefore, there is a perception that the alliance guarantee may not be possible to support with conventional power and missile defense alone, especially for allies that are directly threatened by nuclear weapons. As a representative example, the United States deployed tactical nuclear weapons to the ROK for thirty-three years from 1958 to 1991. The largest number of tactical nuclear weapons in the ROK was about 950 in 1967.[35] However, after the end of the Cold War in 1991, the United States withdrew all nuclear weapons from the ROK as the strategy for deploying nuclear weapons abroad changed. As the DPRK continues to advance its nuclear capabilities, there is a demand that "nuclear must be deterred with nuclear," and there is a debate among the South Korean people about demanding the redeployment of tactical nuclear weapons in the ROK by the United States. In such a situation, the US-ROK alliance is bound to be concerned about an effective and appropriate level of nuclear deterrence. In particular, those in the ROK (or, for example, Japan) who feel threatened by the DPRK will be more concerned about the credibility of the United States' commitment to extended deterrence. There is a difference in perspective between the ROK and United States in this regard. For example, when the United States retired its nuclear-tipped cruise missiles in 2010, the ROK and Japan strongly opposed the move. This was the trigger for the launch of the US-ROK Deterrence Strategy Committee (DSC). The same considerations may have been behind the restoration of low-yield nuclear weapons in the United States' 2018 Nuclear Posture Review.

Third, Denis Healey, who was British Secretary of Defense from 1964 to 1970, said, "it takes only 5% credibility of American retaliation to deter the Russians, but 95% to reassure the Europeans,"[36] and that statement became the background of the "Healy Theory." Since deterrence strategies are based on anxiety and fear, those who feel fear

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[34] The term "Leaky Umbrella" is used in Justin V. Anderson, Jeffrey A. Larsen, and Polly M. Holdor, "Extended Deterrence and Allied Assurance: Key Concepts and Current Challenges for U.S. Policy," published by the USAF Institute for National Security Studies, USAF Academy, Colorado as INSS Occasional Paper 69, September 2013, https://www.usafa.edu/app/uploads/OCP69.pdf

[35] *Hankoyreh*, "What is the tactical nuclear weapon that makes the Korean redeployment controversial?" September13, 2017.

[36] Dennis Healey, *The Time of My Life*, London: Michael Joseph, 1989, 243.

easily are deterred even if they have low trust. Therefore, there is an opinion that the United States should put considerable effort into securing the alliance because its allies feel the threat of the enemy is greater than the guarantee of the alliance provided by the United States. In particular, in 2016, when the DPRK's nuclear threat was growing, the US military conducted a rotational deployment of strategic assets to enhance the credibility of its extended deterrence on the Korean Peninsula, despite the high cost of deploying strategic assets.

Fourth, "Status Quo Ante" means that the allies wish the extended deterrence and alliance guarantee policies to be maintained at the same level as in the past. This is similar to a physical phenomenon that maintains the current state and resists change, such as the moment of inertia. A representative example of such a phenomenon in the security sphere is the concern expressed by allies about policy changes in the 2010 US Nuclear Posture Review (NPR) that emphasized the reduction of the role of nuclear weapons.[37] Because of the policy, the United States had retired nuclear tipped Tomahawk cruise missiles. The ROK and Japan recognized the missile as one of the core armaments of the nuclear umbrella providing a key means of deterring nuclear and WMD threats from DPRK, China, and Russia. In response, Japan expressed concern about the reduction of the US nuclear deterrent in a US-Japan security meeting, and the US-ROK Extended Deterrence Policy Committee (EDPC) was launched in 2012 to strengthen security cooperation. This can be said to reflect the unstable psychology of a country that does not have adequate deterrence measures.

Lastly, "Putting the Cart Before the Horse" means that the allies do not feel the necessity of possessing their own nuclear weapons only when they perceive it to be safe to forego that choice, and thus extended deterrence fails as a means of non-proliferation in situations where they do not feel safe. That is, if extended deterrence is emphasized only as a means of securing non-proliferation, without a guarantee of alliance as well, it may not be successful in securing non-proliferation. In the NPR, the United States emphasizes that extended deterrence contributes to maintaining a nuclear non-proliferation regime by providing its allies with extended deterrence so that their allies do not feel the necessity to develop nuclear weapons. In particular, according to the Nuclear Non-Proliferation Treaty (NPT), the international community distinguishes between nuclear and non-nuclear states, and non-nuclear states are prohibited from developing and possessing nuclear weapons. Therefore, allies that cannot develop nuclear weapons and do not possess reliable means of deterring nuclear threats on their own are making the sacrifice of abandoning nuclear development because they believe in the security guarantee from the United States. In such a situation, if the United States emphasizes its role only in the aspect of nuclear non-proliferation without a clear and credible commitment to provide extended deterrence, dissatisfaction among allies will inevitably arise.

[37]United States Department of Defense, *2010 Nuclear Posture Review*, 2010, 15.

Along with that, there is a skeptical view of extended deterrence due to the recognition of the aforementioned challenges. An American scholar, Jeffrey Lewis, said, "The nuclear umbrella does not exist and the United States has no obligation to use nuclear weapons under certain circumstances. The extended deterrence is nothing more than a political rhetoric that our allies want to hear."[38] There are such skeptical perceptions and concerns about extended deterrence in the ROK as well. In this regard, it is suggested to enhance the credibility and implementation of extended deterrence as follows.[39]

Frequently discussed options to enhance the credibility of extended deterrence are redeployment of the US tactical nuclear sharing and making an operational plan using nuclear weapons. However, these methods are not feasible in the near future considering the policy direction of the ROK and the characteristics of the US nuclear command and control system. Therefore, to propose realistic and reasonable measures, the framework of extended deterrence, which includes the concepts of "political resolve," "political and military support," and "military capabilities" were reviewed.[40]

In terms of political resolve, to strengthen extended deterrence, a joint declaration between the ROK and the United States and diplomacy between the nations' leaders may be considered. In particular, the strengthening of extended deterrence can be emphasized in a specific and strong tone in a joint declaration at a summit meeting between the presidents of the United States and the ROK. In addition, security guarantees for alliances and the tailored deterrence strategy may be specified in national strategic guidelines such as the US National Security Strategy and the NPR.[41]

For political and military support, various security consultative bodies such as the US-ROK Security Council, Deterrence Strategy Committee, and Extended Deterrence Policy Committee should be continuously developed to strengthen the common understanding between the ROK and the United States. For example, in the preamble to the 52nd SCM (Security Consultative Meeting) in 2020, "The Secretary and the Minister committed to ensure that the Alliance deterrence posture remains credible,

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[38]Lewis, Jeffrey, "Rethinking extended deterrence in Northeast Asia." Nautilus Institute workshop, 2010.

[39] Similar concerns were expressed in Davis, Paul K., Jeongeun Kim, Junho Park, and Peter A. Wilson, "Deterrence and Stability for the Korean Peninsula," *Korean Journal of Defense Analysis*, 28(1), 1-23, 2016, available at https://www.researchgate.net/publication/298716189_Deterrence_and_Stability_for_the_Korean_Peninsula

[40]Justin V. Anderson, Jeffrey A. Larsen, "Extended Deterrence and Allied Assurance: Key Concepts and Current Challenges for U.S. Policy," *INSS Occasional Paper*, USAF Academy, September 2013, 9-31.

[41]Although there is unlikely to be a fundamental solution to strengthening extended deterrence due to a gap in the credibility of the US deterrence policies, the efforts of both countries to reinforce their alliance should continue at a level that each can accept.

capable, and enduring. To this end, the two leaders pledged to enhance deterrence through the implementation of many of the policy recommendations from the Extended Deterrence Joint Study."[42] Based on the statement, it is necessary to further strengthen the deterrence effect by implementing the policy suggestions of the joint research through the deterrence consultative bodies. And above all, the presence of US forces in Korea exerts a very important deterrence effect. Therefore, the solidity of the alliance needs to be demonstrated and the continued presence of US forces in the ROK needs to be confirmed. In addition, normalizing the reduced US-ROK joint exercise and rotational deployment of strategic assets could be one way to strengthen deterrence.

Finally, military capabilities can be a decisive means to directly increase the credibility of the extended deterrence. In the 2018 NPR, the United States announced the development of low-yield SLBMs and sea-launched cruise missiles (SLCMs), and it mentioned that these low-yield SLBMs and SLCMs would strengthen the assurance of deterrence to the Asian alliances.[43] [44] To ensure nuclear deterrence in Europe, the United States deployed B-61 gravity nuclear bombs to five NATO countries (Germany, Belgium, the Netherlands, Italy, and Turkey) and adopted nuclear sharing using the dual-purpose aircraft of those countries. On the other hand, after the withdrawal of tactical nuclear weapons from the ROK, strategic nuclear weapons became a means of guaranteeing nuclear deterrence, and the reliance on these weapons has raised doubts about their actual use in a retaliation-required situation.[45] Therefore, possessing nuclear weapons of various yield and capabilities can fill the void in nuclear power, enable flexible responses, and enhance the will-to-execute and credibility of extended deterrence.

There are also problems, however, in continuously strengthening nuclear deterrence on the Korean Peninsula. The more aggressive the nuclear posture, the greater the possibility of using nuclear weapons due to uncertainty about the intentions of the other party. In addition, strengthening nuclear deterrence may lead to an intensifying

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[42] *Yonhap News*, "Joint Statement of the 52nd ROK-U.S. SCM," October 15, 2020.

[43] US Department of Defense, *2018 Nuclear Posture Review*, 2018, 12.

[44] The addition of these weapons by the United States in the 2018 NPR reflected the concern that the ROK has regarding US extended deterrence. The ROK continues to build its conventional defensive capabilities. Although "nuclear sharing," referring to US extended deterrence, is an effective approach, it does not really constitute "sharing" of nuclear weapons between the United States and the ROK due to the nature of the US nuclear command and control system. To clarify this relationship in the 2018 NPR, "nuclear sharing" was deleted and replaced by "burden sharing."

[45] When considering planning/employment as well as deterrence of nuclear weapons, it would be natural for the ROK to actively participate in the nuclear planning/employment program on the Korean Peninsula (which is Korean territory) with the United States, given the ROK/United States alliance. The point here is that the withdrawal of US nuclear weapons from the ROK has raised some doubts in the ROK about US extended deterrence because the lack of the physical presence of nuclear weapons in the ROK appears to further remove decisions about nuclear forces from ROK involvement.

arms race between hostile countries, such as in development and deployment of nuclear weapons and missile defense systems. In particular, since the DPRK insists on possessing nuclear weapons to ensure its survival under the threat it perceives from US nuclear weapons, strengthening US nuclear deterrence may have a negative impact on the progress of denuclearization on the Korean Peninsula. Therefore, it is also necessary to consider balancing the goals of strengthening nuclear deterrence and creating a peaceful security environment on the Korean Peninsula.

V. CONCLUSION

In this paper, several nuclear use cases were investigated based on the DPRK's nuclear capabilities and nuclear strategy. The fact that the DPRK has maintained an offensive military strategy for a long time and has recently announced its tactical nuclear development program shows that it is highly likely to adopt an offensive nuclear strategy in the future. Due to the presence of such a strategy, the possibility of using nuclear weapons is expected to increase, and the possibility of a direct attack on the ROK Army Mobile Corps and/or an EMP attack on Seoul and Busan might also be expected to be high. To prevent those nuclear use cases from becoming reality, the credibility and effectiveness of the United States' extended deterrence should be strengthened in its political and military aspects.

Recently, the DPRK has been taking a double stance, in which while they have restored inter-Korean military leadership communication lines,[46] Kim Yo-Jong has publicly demanded the suspension of US-ROK joint exercises[47] and the withdrawal of US troops from Korea.[48] Therefore, although there are inevitably trade-offs with goals such as the establishment of peace on the Korean Peninsula, strengthening security cooperation within the US-ROK alliance is needed in the current situation where progress on the denuclearization of the DPRK is not achieved and is delayed.

[46] *Yonhap News*, **"Restoration of inter-Korean military communication lines,"** July 27, 2021.
[47] *Yonhap News*, **"**Kim Yo-jong, 'ROK-US military exercises obscure the future of inter-Korean relations... Watch the South Korea's decision,'" August 1, 2021.
[48] *Joongang News*, Kim Yeo-jung's first request for "withdrawal of U.S. troops"... Difficulties in denuclearization negotiations rise again," August 11, 2021.