North Korea's Nuclear and Ballistic Threats and the Tailored Deterrence Strategy

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Abstract

North Korea's nuclear weapons and ballistic missile programs threaten South Korea and its neighbors. Pyongyang's engineers are likely capable of producing a warhead small enough to place it atop a missile. As its ability to engineer warheads for flight and reentry improves, North Korea increasingly endangers the United States. Deterring Pyongyang is extremely difficult given North Korea's conventional, unconventional, and cyber capabilities. South Korean and American strategists have reponspded by developing a tailored deterrence strategy to address specific threats. At the operational level, this is supported by the Combined Counter-Provocation Plan. Ballistic missile defense, including the ability to detect, defend, disrupt, and destroy North Korea's missiles, is critical to the success of the tailored deterrence strategy. South Korea opted to develop its Korean Air and Missile Defense and Kill Chain system. These systems are independent of American ballistic missile defense systems. The Korean systerms were conceived and developed amidst plans to transfer Wartime Operational Control from the U.S. to South Korea. Because transfer has been postponted, there is less rationale for maintaing separate systems. Despite the official desire to keep these systems independent, South Korea needs to develop options for enhancing interoperability with American missile defense systems to support the tailored deterrence strategy.

Keywords: Nuclear weapons, ballistic missile, intercontinental ballistic missile, Tailored Deterrence Strategy, Defense Reform Plan 307, Deterrence Strategy Committee, Kill Chain, Korean Air and Missile Defense System, Wartime Operational Control

Introduction

Murphy's First Corollary describes the challenges in deterring North Korea's nuclear and ballistic missile programs: "left to themselves, things tend to go from bad to worse." The Pyongyang government has

repeatedly shown that it doesn't adhere to global rules. North Korea signed the Nuclear Nonproliferation Treaty, then declared it was withdrawing from the treaty. Similarly, the country pledged to denuclearize, only to renege on its commitment. Nuclear weapons are central to the regime's identity, as well as Kim Jong-un's survival. At a recent Workers' Party Congress, Kim Jong-un made it clear that North Korea is a nuclear power and will remain one.

Kim Jong-un has accelerated North Korea's ballistic missile development efforts. There were 18 missile tests during his father's 18-year rule. In contrast, North Korea has conducted 25 missile tests since Kim Jong-un assumed power five years ago. North Korean scientists appear increasingly capable of miniaturizing nuclear warheads to the degree they can be integrated into the country's missiles. Engineers are working to overcome other technical challenges associated with long-range flight and reentry. Pyongyang's objectives are clear, and North Korean rocket scientists continue to learn with each test.

This paper analyzes the North Korean nuclear weapons program and strategies to deter the threat. The first part describes recent development in the North Korean nuclear program, as well as an assessment of Pyongyang's intercontinental ballistic missile (ICBM) capabilities using the framework developed by Jeffrey Lewis. The second part examines the tailored deterrence strategy as a means to counter this threat. This paper concludes by proposing the integration South Korea's Kill Chain and Korean Air and Missile Defense systems with American systems to enhance deterrent and defense capabilities.

North Korea's Nuclear Tests

Assessing North Korea's nuclear weapons' program has proved challenging despite the considerable efforts of the scientific and intelligence communities over the past three decades. Nonetheless, most analysts believe North Korea is capable of weaponizing both Plutonium and Highly Enriched Uranium (HEU). Additionally, the series of four underground nuclear tests has each produced higher yields.[1] Examining each test, North Korean pronouncements, and international reactions to verify Pyongyang's claims provides insight into the evolution of North Korea's nuclear program.

North Korea first tested a nuclear weapon on October 9, 2006, detonating the device in a tunnel at the Punggye-ri Nuclear Test Site.

Located in the remote mountains of North Hamgyong Province, North Korean engineers had spent years preparing and testing the site. The first device was assumed to use plutonium processed at the Yongbyon Nuclear Scientific Research Center (Yongbyon). However, many experts questioned whether a nuclear explosion occurred due to the small yield of the test. Speculation ranged from a conventional explosion designed to give the appearance of a nuclear test to a fizzle in which the bomb failed to meet its projected yield. After a week of uncertainty, the Office of the Director of National Intelligence (ODNI) announced that specially equipped American military aircraft detected radioactive isotopes, confirming that North Korea detonated a nuclear device.[2] The ODNI assessed the strength of the blast at less than one kiloton.[3]

Before the ODNI announcement, an unnamed North Korean official was quoted as saying that North Korea could launch a nuclear missile unless the United States sits down for face-to-face talks.[4] This threat required the international community to believe that North Korean engineers and scientists had mastered the many technologies required to mount a nuclear warhead to a ballistic missile. At the time of the test, few experts believed North Korea possessed such capabilities.

Pyongyang tested a second nuclear device on May 25, 2009. Like the first test, the weapon was detonated in a tunnel at the Punggye-ri Nuclear Test Site. However, South Korea, the United States, and the Preparatory Commission for the Comprehensive Test Ban Treaty Organization (CTBTO) were unable to detect the radionuclides frequently associated with an atomic explosion.[5] The inability to detect radionuclides doesn't mean that North Korea detonated conventional explosives. The depth of the test and type of rock may have contained the explosion; these factors shouldn't be discounted given North Korea's experience and expertise in building deep tunnels in hard rock. Based on seismic recordings, which varied from country to country, analysts in each country offered different estimates of the yield. The ROK Ministry of National Defense estimated the yield between one and 20 kilotons,[6] while the U.S. Intelligence Community assessed that "North Korea probably conducted a nuclear explosion" with an explosive yield of "a few kilotons."[7]

North Korea launched two short-range surface-to-air missiles on the same day of its second nuclear test. Additional tests followed, with three short-range missiles launched on May 26 and five short-range missiles launched on May 27. In early June, American and South Korean defense leaders separately confirmed that North Korea was making preparations

to fire medium- and long-range missiles. Although North Korea did not launch its long-range missiles at this time, Pyongyang launched seven missiles into the East Sea on July 6.[8] However, North Korea had demonstrated increased capability earlier in the year with the launch of a three-stage rocket carrying the satellite Kwangmyongsong-2 on April 5.

On February 12, 2013, the Korea Central News Agency (KCNA) announced that North Korea had conducted its third nuclear test. The test was the first under Kim Jong-un's leadership of the country. Despite sending planes and ships to collect samples, analysis done by the ROK Nuclear Safety and Security Commission failed to detect any radioactive isotopes; none of the agency's 122 unmanned radiation monitoring systems reported any changes.[9]

As with previous underground tests, assessments of the device's nature and yield varied greatly. Based on seismic activity, the CTBTO estimated the third test to be twice as large as the second.[10] The ROK Ministry of National Defense, using analysis developed by the Korea Institute of Geosciences and Mineral Resources, assessed the strength of North Korea's nuclear test to be 6-7 kilotons.[11] The ODNI estimated the explosion yield was approximately several kilotons.[12]

The KCNA further reported that the test involved a "miniaturized and lighter nuclear device with greater explosive force than previously."[13] Proving the veracity of Pyongyang's miniaturization claims was even more difficult than assessing explosive yields. While there are substantial doubts that North Korean scientists have succeeded in producing a miniaturized nuclear weapon, senior defense officials in South Korea and the United States don't dismiss the possibility. Appearing before the National Assembly's Defense Committee on June 14, 2011, South Korean Defense Minister Kim Kwan-jin stated, "It has been a long time [since the North's nuclear test], so we believe the North had enough time to make a smaller and lighter nuclear weapon."[14] A year and a half after the third nuclear test, General Curtis M. Scaparrotti noted that North Korea had made significant progress in reducing the size of nuclear weapons. The senior American commander in South Korea stated, "they have the capability to have miniaturized the device at this point."[15]

North Korea's fourth nuclear test occurred on January 6, 2016. Although the seismic activity was similar to the third test, KCNA announced that North Korea had successfully tested a hydrogen bomb. Producing a hydrogen bomb—requiring a two-phase explosion that includes a nuclear fission trigger to initiate a fusion reaction—is

considerably more challenging than an atomic weapon; only China, Great Britain, France, Russia, and the United States have successfully tested hydrogen weapons.[16]

Consequently, most independent experts, as well as officials and agencies in South Korea, doubted North Korea's claims. They contended the device had been more likely to be a boosted fission weapon. Even if Pyongyang produced a boosted fission weapon, a ROK Ministry of National Defense official concluded that the test was likely a failure due to the small size of the yield.[17] Regardless, North Korea's statement underscores the fact that hydrogen weapons are generally smaller and lighter than atomic weapons, making them more suitable for use in warheads.

Analytic uncertainties and Pyongyang's hyperbole notwithstanding, there are two key lessons to be learned from North Korea's first four nuclear tests. First, North Korea's objective is to develop a nuclear weapon capable of being delivered by a ballistic missile. Ballistic missile tests or official statements related to ballistic missiles have accompanied each of the four nuclear tests. Second, North Korean scientists and technicians appear to have learned from an initial failure, and have pursued more ambitious objectives with each test. While it is impossible to verify all claims, nuclear yields have increased significantly. Knowing North Korea's objective and current nuclear weapons capability, this analysis moves to the next step and examines the capabilities Pyongyang must master to achieve its goal of developing an intercontinental ballistic missile.

Assessing North Korea's Nuclear Capabilities

Although much of the current debate surrounding Pyongyang's nuclear weapons has focused on miniaturization, this is one capability (albeit a critical one) that North Korean scientists and engineers must perfect in order to arm a ballistic missile with a nuclear warhead. Jeffrey Lewis, Director of the East Asia Nonproliferation Program at the Middlebury Institute of International Studies at Monterey, posed three questions that will serve as a framework for assessing North Korea's nuclear capabilities:

Can North Korea make a nuclear weapon small enough?

Can North Korea's compact nuclear weapon survive the shock, vibration and temperature change

associated with ballistic missile flight?

Can North Korea construct a reentry vehicle that can survive the extreme heat of reentry, a problem

that gets worse with range?[18]

While the last question primarily affects Pyongyang's abilitiy to target the U.S., North Korea's ability to address the first two questions affects South Korea and other countries in the region.

North Korea's regime is well-known for making outrageous and often false claims. However, its latest claim to have miniaturized a nuclear device seems plausible. As noted, the Commander of U.S. Forces, Korea opined that North Korea likely possessed the capability to miniaturize a nuclear weapon in October 2014. In March 2016, South Korean Defense Minister Han Min-koo concurred with the assessment, stating, "Given the time that has elapsed since its first nuclear test, we believe that North Korea has achieved a significant level of mi niaturization."[19]

The U.S. Intelligence Community has often stated that North Korea may have followed by the path of other countries in focusing on developing smaller nuclear weapons weighing approximately 1,000 kg.[20] The U.S. Defense Intelligence Agency was even more explicit, assessing that North Korea might try to build a nuclear device in the 650-750 kg range that is similar to the American Mark 7 design. In either cases, the weapons are considered unreliable without testing.[21] Lewis notes that many believed North Korea's failed first test was a result of trying to build a compact device at the outset.[22]

When North Korea's first test in 2006 produced a very disappointing yield, many experts took the small yield to mean that North Korea had tried to skip directly to a compact device, resulting in a failure. But, since then, North Korea has conducted three more nuclear tests that produced far higher yields with number of test increasing. Following the test in 2013, the North Koreans announced they had "miniaturized" their nuclear devices. The proliferation of design information has allowed countries to focus efforts on developing smaller warheads from the outset. The Pakistani nuclear program benefitted from receiving Chinese designs of a uranium-based warhead weighing approximately 500 kg. and measuring 90 cm. in diameter.[23] In turn, the Pakistanis passed this along to the Libyans.

If North Korean scientists were able to build a similarly-sized warhead, they would certainly be able to mount it to a Nodong missile. Dr. Bruce E. Bechtol, Jr., an Angelo State University professor who has

authored several books on the North Korean military, estimates Pyongyang has had this capability since 2010.[24] Officials increasingly believe North Korea is capable of fitting a warhead onto an ICBM. During an April 7, 2015 briefing, Admiral William Gortney, commander of the North American Aerospace Defense Command, told reporters that the Pentagon believed North Korea was capable of placing miniaturized warheads on the KN-08 ICBM.[25] Six days later, South Korea's Vice Defense Minister Baek Seung-joo dismissed Admiral Gortney's claims and repeated Seoul's position that North Korea had yet to build a nuclear weapon small enough to place on a warhead despite its advances in miniaturization.[26] The differing assessments marked a high-level split between senior defense officials, yet reflected the ongoing debate in academic and policy circles over North Korea's miniaturization capabilities. Lewis estimates the North Koreans could have miniaturized a warhead weighing 450-750 kg., and a diameter between 60 and 90 cm. as a result of their previous tests.[27]

While miniaturization is a the key first step, Lewis notes that any North Korean warhead must be engineered to survive the shock, vibration and temperature change that occurs during ballistic missile flight. These challenges go beyond the issue of miniaturization, and include the design of the missile and integration of the warhead. Moreover, it is extremely difficult to replicate the conditions of ballistic missile flight in a laboratory. Melissa Hanham of the James Martin Center for Nonproliferation Studies pointed out the need for operational testing after North Korea's *Rodong Sinmun* published a photograph of Kim Jong-un inspecting a miniaturized nuclear device, " It's very hard to determine or to demonstrate the capability short of testing on the tip of flying missiles."[28] In addition to overcoming the engineering challenges inherent in designing and integrating nuclear warheads and ballistic missile, North Korea must consider the political risk associated with a test flight of an actual warhead.

Both the U.S. and China faced a similar challenge in developing ICBMs capable of delivering nuclear warheads. When the Soviet Union ended a de facto moratorium on atmospheric testing in September 1961, President Kennedy approved a series of atmospheric tests of American nuclear weapons and missile. Of the 36 tests conducted under Operation Dominic, Frigate Bird was the only test involving a live warhead and a ballistic missile.[29] On May 6, 1962, the *USS Ethan Allen* launched a Polaris A2 missile. After flying 2700 km., the warhead successfully

detonated. However, subsequent tests indicated that the warhead was unreliable.[30] Frigate Bird was the only American test of a nuclear ICMB from launch to detonation.[31]

China faced similar problems in testing the DF-2 ballistic missile in the 1960s. Like the Americans, the Chinese faced similar problems in replicating the extreme and varying conditions of ICBM flight. The Chinese leadership also carefully considered the risks associated with an operational test of a live warhead. Premier Zhou Enlai ultimately approved the test after considerable discussions between weapons experts and the central leadership. In October 1966, China successfully fired a nuclear-armed DF-2 missile.[32]

North Korea doesn't appear to be at the stage where it is considering an operational test of an ICBM with a nuclear warhead. Pyongyang has yet to test the KN-08. However, like the U.S. and China, North Korea will likely have to consider an operational test in order to evaluate the reliability of its weapons. The results of such a test will have significant ramifications for both North Korea's nuclear program and those seeking to deter it.

Lewis's final question involves overcoming the significant technical challenges associated with designing, building, and testing a re-entry vehicle that can successfully re-enter the earth's atmosphere. Objects re-entering the atmosphere from the vacuum of space encounter enormous amounts of friction that generate extreme heat; ballistic missiles typically re-enter the earth's atmosphere at speeds reaching 7 km/second.[33] For a warhead to be operable, it must be built in a manner that allows it to survive reentry without burning up while remaining on course. The performance of warhead is a function of both the shape of the re-entry vehicle and its composition.

There are three shapes of re-entry vehicles: blunt, slender, and triconic; the latter is a hybrid between the blunt and slender warheads. North Korean military parades have featured blunt and triconic re-entry vehicles. Pyongyang has yet to exhibit the slender cones used by advanced nuclear powers.[34]

Blunt re-entry vehicles function by creating an air cushion and moving the heat energy around the vehicle; the Apollo Command Module is perhaps the most famous blunt re-entry vehicle. While blunt re-entry vehicles are simple and robust, they are of limited military use. If North Korean were to package a nuclear warhead in a blunt re-entry vehicle, Lewis notes the weapon would be "inaccurate, very heavy and

potentially vulnerable to theater missile defense systems."[35] In a separate article, Lewis, non-proliferation research David Schmerler, and aerospace engineer John Schilling state, "If North Korea is planning on fielding such warheads, they are playing it very safe technologically, but they are limiting themselves to a system that can be used only against large, undefended targets."[36]

As implied by the name, a triconic warhead has three cones. This type of warhead is only found in nuclear weapons.[37] In addition to the design of the cone, triconic warheads deal with the problem of extreme temperatures by heat ablating materials; i.e., materials that dissipate heat by vaporization or evaporation.[38] North Korea has showcased missiles with triconic warheads during military parades. Additionally, the Iranians modified a North Korean Nodong missile, incorporating a triconic warhead onto the missile.[39]

Lewis's framework outlines significant challenges to arming a ballistic missile with a nuclear warhead. As noted, other states have overcome these challenges. Lewis notes that North Korea's effort is aided experience gained through "50 years of space flight, a large body of open source information, better computer simulation capabilities," as well as assistance from other countries. While officials often discount North Korea's capabilities, it is increasingly probable that North Korea will develop, field, and test nuclear-tipped ICBMs.

Tailored Deterrence Strategy

During the 45th Security Consultative Meeting (SCM), South Korean and American defense leaders formally endorsed a bilateral "Tailored Deterrence Strategy Against North Korean Nuclear and Other WMD Threats."[40] The agreement creates a "strategic, policy-level framework within the alliance for deterring specific threats."[41]Defense Secretary Chuck Hagel said the agreement would "help us work together more seamlessly to maximize the effects of our deterrence."[42] Defense Minister Kim Kwan-jin said both sides agreed to a "more future-oriented and comprehensive strategic alliance."[43]

The announcement was a significant milestone in the evolution of South Korean and American deterrence strategy against North Korea. Significantly, the agreement reflected the need for a combined (ROK-U.S) tailored deterrence strategy in dealing with threats from Pyongyang. This section describes the evolution of this combine strategy, beginning with a brief comparison between traditional deterrence and

tailored deterrence. It reviews past instances of tailored deterrence, which often involved independent actions South Korean and American. Lastly, this section describes combined tailored deterrence efforts following the October 2013 endorsement at the SCM.

Deterrence is frequently associated with the Cold War rivalry between the U.S. and the Soviet Union. In this bipolar world, each state viewed the other as posing the only major threat of attack. Because the stakes were so high, both the U.S. and Soviet Union invested significant resources in developing deterrence strategies. In addition to deploying nuclear weapons, strategists sought to develop theories of deterrence. Thomas Schelling's *The Strategy of Conflict* (1963) and *Arms and Influence* (1966) remain important works in strategy and international relations theory.[44]

The end of the Cold War, the breakdown of the bipolar world, and the proliferation of nuclear weapons presented new problems to strategists, policy makers, and practitioners. The 1994 North Korean nuclear crisis highlighted the challenge of adapting deterrence theory to the post-Cold War era and the rise of regional adversaries armed with weapons of mass destruction. The Clinton administration concern over Pyongyang's ability to reprocess spent fuel rods led it to consider preemptive strikes on the facilities on Yongbyong. The Americans went as far as to deploy F-117 stealth fighters to Korea.[45] However, the Clinton administration eventually rejected this plan due to the risk of retaliation that could escalate to war.[46]

The U.S. faced a similar situation in the summer of 2006 as North Korea prepared to launch a Taepodong-2 missile. Writing in *The Washington Post*, former and future Defense Secretaries William Perry and Ashton Carter urged the Bush administration to "immediately make clear its intention to strike and destroy the North Korean Taepodong missile before it can be launched."[47] By this time, North Korea had conducted its first nuclear test. Like the Clinton administration, the Bush administration decided against a preemptive strike.

The Bush administration's reluctance to act came shortly after it outline a vision for tailored deterrence. Released in February 2006, the *Quadrennial Defense Review (QDR) Report*, continues "a shift from a one-size-fits-all notion of deterrence toward more adaptable approaches suitable for advanced military competitors, regional weapons of mass destruction states, as well as non-state terrorist networks, while assuring allies and dissuading potential competitors."[48]

Dr. M. Elaine Bunn, a senior research fellow at the Institute for National Strategic Studies at the National Defense University, noted that the QDR failed to adequately define the term or describe the means to achieve tailored deterrence.[49] The objective of deterrence remains largely the same, "to prevent a hostile action (such as aggression or WMD use) by ensuring that, in the mind of a potential adversary, the risks of action outweigh the benefits, while taking into account the consequences of inaction."[50] Dr. Bunn then provides three aspects of tailored deterrence that must be analyzed further in order to develop this concept: tailoring to specific actors and situations; tailoring capabilities; and, tailoring communications.[51] Dr. Bunn points out that specific North Korean actions must be deterred—providing nuclear weapons to terrorists, invading South Korea, and using nuclear weapons—rather than simply desiring to "deter North Korea."

North Korea presents unique challenges to the theory and practice of tailored deterrence. Dr. Michael Raska of Singapore's Nanyang Technological University describes a "spectrum of threats" that extend beyond nuclear weapons and ballistic missiles.[52] North Korea has demonstrated its conventional troops, special operations forces, and cyber capabilities in recent attacks including the sinking of the *ROKS Cheonan*, bombardment of Yeonpyoung Island, and hack of Sony Pictures.[53] In addition to the diversity of threats, Dr. Raska notes a key challenge is to "ascertaining North Korea's threshold for limited conflicts, asymmetric attacks, and provocations" that inflict damage on South Korea without provoking retaliation from the ROK-U.S. alliance.[54]

The ROK Government took initial steps toward a tailored deterrence strategy in the wake of the 2010 attacks on the *ROKS Cheonan* and Yeonpyoung Island. In December 2009, President Lee Myung-bak commissioned 15 experts to reexamine Defense Reform Plan (DRP) 2020. Led by Dr. Rhee Sang-woo, the Defense Reform Committee's year-long review encompassed the tragic events of 2010. A key element of DRP 307 (named for the date the president approved the commission's recommendations), the resulting Doctrine of Proactive Deterrence enables the South Korean military to make "prompt, focused and proportional retaliation against North Korea's attacks."[55] Previously, the Korean government had used a "Defense by Denial," seeking to contain North Korean provocations in order to preserve inter-Korean relations.[56] In a subsequent analysis of DRP 307, Dr. Rhee states, "DRP 307 induces North Korea to non-belligerent policy options. If North

Korea realizes that it is not possible to achieve national unification through belligerent means, then it will seriously and sincerely consider non-belligerent alternatives."[57]

Shortly after the release of DRP 307, General Jung Seung-jo, Chairman of the ROK Joint Chiefs of Staff (JCS), and General James D. Thurman, Commander of the Combined Forces Command, signed the Combined Counter-Provocation Plan (CCP). Following the attack on Yeonpyoung Island, the ROK and U.S. JCS Chairmen agreed to develop a plan to counter North Korean threats.[58] The CCP is a South Korean-led, U.S.- supported plan that facilitates a "strong and decisive combined South Korean and U.S. response to North Korean provocations and threats."[59]

Korean and American defense officials continued to refine deterrence strategies for dealing with North Korea's WMD and ballistic missiles at the 7th Korea-U.S. Integrated Defense Dialogue on April 14-15, 2014. Following guidance from the 47th SCM, the two delegations signed the terms of reference establishing the Deterrence Strategy Committee (DSC), combining the Counter-Missile Capabilities and Extended Deterrence Policy Committees.[60] The DSC is responsible for developed the "4D Operational Concept," a proactive means to "detect, defend, disrupt and destroy" North Korean nuclear and missile threats.[61] The Ministry of National Defense noted that the DSC will "more systematically utilize" American capabilities and South Korea's Kill Chain and Korea Air and Missile Defense (KAMD) systems; both systems are under development.[62] Because the Kill Chain and KAMD are central to tailored deterrence, the remainder of this paper focuses on these systems.

Korea Air and Missile Defense and the Kill Chain

In 2006, the ROK Ministry of National Defense announced plans to develop the KAMD, an indigenous missile defense system. Despite the combined command structure on the peninsula, South Korea has pursued a system that is largely independent from the U.S., as well as the joint system being developed between the U.S. and Japan. Military officials initially stated the American and joint systems were not suited for the peninsula's geography and terrain; they also cited the high cost of these systems. During Lee Myung-bak's administration, defense officials stated the weapons constituting the American and Japanese ballistic missile defense system—the Patriot Advanced Capability-3 (PAC-3),

Terminal High Altitude Area Defense System (THAAD), Aegis ships equipped with Standard Missile-3 (SM-3), and early warning radars—were not needed to protect South Korea from North Korean short-range missiles.[63]

At the outset, the KAMD was envisioned to consist of PAC-2 missile interceptors and radar.[64] To this end, South Korea acquired 48 used PAC-2 missile interceptors from Germany in 2008; it would ultimate possess nearly 300 PAC-2 missiles. The ROK upgraded its capabilities in 2014, purchasing 136 PAC-3 missiles.[65]

In 2009, the ROK Defense Acquisition Program Administration announced it would purchase two Green Pine Block-B (Super Green Pine) radar systems from Israel.[66] Capable of tracking dozens of targets at a reported detection range of more than 800 kilometers, the Super Green Pine systems would cover all of North Korea.[67] The ROK Ministry of National Defense approved construction of an Air and Missile Defense-Cell (AMD-Cell) earlier in the year. The AMD-Cell will integrate information obtained from Super Green Pine radars to counter low-flying, short- and medium-range missiles.[68]

KAMD expanded to include a sea-based component. South Korea's three *Sejong Daewang* (*Sejong* the Great)-class destroyers were already equipped with the Aegis radar. In 2009, the ROK Ministry of National Defense officially requested to purchase the SM-2 missile from the U.S.[69] Four years later, South Korea announced that it would upgrade its Aegis destroyers with the SM-6. With a range of 320-400 kilometers, the SM-6 is considered more effective in destroying North Korean ballistic missiles.[70] South Korea later announced it would acquire three additional Aegis destroyers.

South Korea's emphasis on the KAMD was reflected in the defense ministry's budget submission for the fiscal years 2014-2018. Of the 214.5 trillion won ($192.6 billion) requested, 70.2 trillion won (13.4%) would be allocated for ballistic missile defense systems associated with KAMD.[71]

In the *2012 Defense White Paper*, the ROK Ministry of National Defense outlined the concept for a preemptive strike capability: "in the event of provocation, our security posture will allow us to conduct swift, accurate, and thorough response within our sovereign rights of self-defense."[72] Developed within the framework of the tailored deterrence strategy, the Kill Chain system is envisioned to find, fix, track, target, and engage North Korean missiles; assessing engaged targets is

the final phase of the process.[73] There is strong support for the Kill Chain system. Speaking at the 2013 Armed Forces Day parade, President Park Geun-hye said South Korea would be "quickly securing abilities to counter nuclear arms and other weapons of mass destruction."[74]

Kill Chain requires a significant investment in intelligence, surveillance, and reconnaissance capabilities needed to "find" North Korean missiles and supporting systems. In February 2013, South Korean defense officials revealed mid- and long-term plans to deploy spy satellites.[75] The ROK Air Force is considering development or purchase of an early warning satellite system capable of detecting missile launches.[76]Although the military has access to information acquired by the *Arirang-3*, a commercial multi-purpose satellite, it continues to rely on the U.S. for intelligence.[77] Additionally, the ROK military is expected to purchase four RQ-4B Block 30 Global Hawk aircraft from Northrop Grumman. South Korea intents to complete the purchase of the high-altitude, unmanned reconnaissance aircraft by June 28, 2019.[78]

In addition to enhancing reconnaissance assets, the ROK military also plans to acquire capabilities to promptly strike fixed facilities and mobile launchers in North Korea. This involves enhancing the accuracy, range, and power of existing surface-to-surface missiles, air delivered munitions, and ship-to-surface missiles. To this end, in May 2013 the ROK purchased over $823 million in weapons to support the F-15 SE aircraft, including Joint Direct Attack Munitions.[79]

Since KAMD and Kill Chain were first proposed, South Korea has repeatedly stated that the systems will be independent of U.S. systems, as well as the those being jointly developed by the Americans and Japanese. It should be noted that these programs began during preparations for transferring Wartime Operational Control (OPCON) from the Americans to the Koreans. Indeed, the KAMD was announced the year following President Roh Moo-hyun's first suggested transferring Wartime OPCON. James Harvey, the Asia-Pacific Editor at Jane's HIS Defense Weekly, states that the transfer of Wartime OPCON was a "key driver" in South Korea's pursuit of enhanced capabilities, to include the KAMD and Kill Chain systems.[80] Because the ROK and U.S. have agreed to a "conditions-based" approach—thus postponing the transfer indefinitely—it appears that much of the original rationale for independent systems is no longer as significant a factor.

Yonsei University Professor Choi Jong-kun questioned the deterrent value of the Kill Chain system following the postponement of Wartime

OPCON. Absent Wartime OPCON, Professor Choi states, "Even if it (South Korea) possessed physical kill chain capabilities, the president would still need to discuss the matter within the Combined Forces Command framework before issuing the order to strike."[81] He notes the contradiction between developing the capabilities for Kill Chain and the postponement of OPCON transfer; delaying OPCON transfer raises questions about South Korea's commitment to the Kill Chain system and authority required to use it. Professor Choi concludes, "The North Korea deterrent is only complete when OPCON is transferred to South Korea as scheduled and Seoul is fully committed to carrying it out."[82] In this line of reasoning, postponing OPCON transfer has reduced Kill Chain's deterrent value

There are other reasons to reconsider maintaining KAMD and Kill Chain as independent systems. First, both systems are primarily composed of American weapons systems and equipment.[83] As noted, major systems in the KAMD and Kill Chain include the PAC-2, PAC-3, SM-2, SM-6, Global Hawk UAV, and Aegis Combat System. Second, South Korea still relies on American early warning satellites. The AMD-Cell integrates "information acquired from the U.S. early missile warning satellites and South Korea's radar system and sends it to Patriot missile units."[84] Third, there are enormous costs associated with developing independent capabilities. The envisioned military satellite system will likely require significant funding. South Korea should consider integrating existing KAMD and Kill Chain capabilities with American systems.

Conclusion

Through four nuclear tests, North Korea has made considerable progress toward its goal of developing a warhead that can be delivered by a ballistic missile. In addition to substantially increasing yields, Pyongyang's scientists and engineered likely have progressed in each of the critical areas outlined by Jeffrey Lewis. North Korea appears capable of miniaturizing weapons to the degree that they can be placed atop its medium-, and perhaps it long-range ballistic missiles. Pyongyang will still need to ensure that its warheads can survive the shock, vibration and temperature change that occurs during ballistic missile flight. ICBM's will need to be engineered to survive reentry. Lewis notes that other countries have overcome these challenges, and North Korea is able to draw on 50 years of experience that is increasingly available in open

source literature. Accordingly, it is increasingly probably that North Korea will develop, field, and test nuclear-tipped ICBMs.

Faced with these threats, Korean and American policy makers have sought to develop a tailored deterrence strategy. These efforts began in parallel, with the U.S seeking to address challenges from advanced military competitors, regional weapons of mass destruction states, as well as non-state terrorist networks. In the wake of the attacks on the *ROKS Cheonan* and Yeonpyoung Island, South Korea sought to deter North Korea's conventional, unconventional, and growing cyber capabilities. These efforts came together when the Minister of National Defense and the Secretary of Defense signed the bilateral "Tailored Deterrence Strategy Against North Korean Nuclear and Other WMD Threats" in October 2013. At the operational level, the Combined Counter-Provocation Plan enables Korean and American forces to decisively respond to North Korean threats and provocations.

Ballistic missile defense, to include the means to detect, defend, disrupt, and destroy North Korean nuclear and missile threats, is central to the tailored deterrence strategy. Despite the combined command structure on the peninsula, South Korea has developed the KAMD and Kill Chain systems that are largely independent from the U.S., as well as the joint system being developed between the U.S. and Japan. This decision has been closely linked to the agreement to transfer Wartime OPCON from the U.S. to South Korea. Because this decision has been postponed, South Korea should consider whether these independent systems best support the tailored deterrence strategy.

Notes:

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[1] Bruce E. Bechtol Jr., "The Military Threat in 2015: The Threat to the ROK-U.S. http://www.icks.org/publication/pdf/2015-SPRING-SUMMER/1.pdf.

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