

The North Korean Missile Threat:

The Hermit Kingdom's Open Ambition

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The Democratic People's Republic of Korea (DPRK) possesses an increasingly capable ballistic missile inventory and continues to make progress on its nuclear weapons program. Despite its struggling economy, North Korea invests significant financial resources into its weapons of mass destruction program in an effort to deter the United States and its allies. The DPRK refuses to cooperate with the international community in efforts to monitor and roll back its nuclear program. Due to a lack of transparency regarding its nuclear and ballistic missile program and unpredictable leadership, North Korea poses a considerable threat to the United States and allies around the world.

Background

For over a decade, North Korea has demonstrated that it has both nuclear and ballistic missile capabilities. These demonstrations include numerous nuclear and ballistic missile tests which antagonize neighbors and further alienate the reclusive nation from the rest of the world.

North Korea has a demonstrated ability to fuel nuclear devices with weapons grade plutonium and uranium. Fissile material for Pyongyang's nuclear program comes primarily from Yongbyon, where the nation has an experimental nuclear reactor that produces reactor-grade plutonium and centrifuges that create enriched uranium. To produce weapons-grade plutonium-239, North Korea reprocesses spent plutonium from the reactor at Yongbyon. In September 2015, Yongbyon's reactor resumed normal operation after years of inactivity, bolstering the DPRK's supply of reactor-grade plutonium. Despite a reinvigorated supply of plutonium, it is likely that the future of Pyongyang's nuclear program will center on highly enriched uranium because of North Korea's large uranium ore reserves and its ability to produce highly enriched uranium-235. To produce highly enriched uranium, Pyongyang uses centrifuges located at Yongbyon, however, some experts suspect that the DPRK has other

centrifuges at clandestine nuclear facilities unknown to outsiders.

The Kim regime conducted underground nuclear tests in 2006, 2009, 2013, and 2016. The 2006 nuclear test involved a device fueled by plutonium and the yield was measured to be less than one kiloton, indicating that the test was not a success. In 2009, the regime conducted another underground test with reprocessed plutonium and a yield of around 4 kilotons. The 2013 underground nuclear test likely used highly enriched uranium rather than plutonium and resulted in a higher yield than the previous tests. The DPRK claimed that the device was a miniaturized nuclear warhead small enough to fit onto a missile. In January 2016, North Korea carried out a fourth underground nuclear test, which the state-controlled media claimed to be a hydrogen bomb. Although the yield for the 2016 test was higher—around 10 to 15 kilotons—many experts argue that it was not in fact a thermonuclear detonation.

In order to weaponize its nuclear capability, the DPRK would need to miniaturize a device small enough to fit on a delivery system, such as a ballistic missile or gravity bomb. Currently, North Korea's only nuclear delivery systems are ground-based ballistic missiles. However, the nation is

currently developing submarine-launched and cruise missiles as well. While concrete evidence indicating that the DPRK has miniaturized nuclear warheads remains elusive, many experts believe that the isolationist nation has the capability to create nuclear warheads that can fit atop its ballistic missiles. Currently, experts estimate North Korea has a nuclear stockpile of 10-16 nuclear weapons with roughly half being plutonium and half uranium. As North Korea continues to advance its nuclear weapons program, the amount of weapons they can produce will increase and some experts claim that the DPRK could maintain a stockpile of 100 nuclear warheads by 2020. In addition to its nuclear program, North Korea is also suspected of possessing both chemical and biological weapon capabilities.



This map shows seismic activity caused by North Korean nuclear tests. Source: BBC

The United States and its allies have made efforts to address North Korea's proliferation activities through diplomacy and sanctions. Diplomatic efforts began in the early 1990s after the United States announced its intentions to withdraw tactical nuclear weapons deployed around the world, including those in South Korea. Following this initiative, both North and South Korea signed the Joint Declaration of South and North Korea on the Denuclearization of the Korean Peninsula in an effort to eliminate nuclear weapons completely from the Peninsula. In early 1992, North Korea signed a safeguard agreement with the International Atomic Energy Agency (IAEA) which called for an initial declaration of its nuclear facilities and allowed the IAEA to independently inspect the sites.

However, in late 1992, the IAEA discovered inconsistencies with the initial report and requested special inspections to investigate the discrepancies. North Korea refused to allow inspections of the suspect facilities and in March of 1993 gave notice to the United Nations Security Council of its intentions to withdraw from the Nuclear Nonproliferation Treaty (NPT). However by mid 1993, the DPRK reversed this decision just before its withdrawal would be complete and began negotiations to allow the IAEA to resume its work. In

1994, the United States and North Korea entered into an agreement known as the Agreed Framework which called for the U.S. to supply the DPRK with a light water reactor facility to generate energy in exchange for "freezing" its nuclear program.

However, by 2003, more complications between North Korea and the IAEA prompted Pyongyang to order inspectors out of the country and withdraw from the NPT. Further efforts to address North Korea's nuclear program were made in the form of multi-lateral discussions between China, the United States, North and South Korea, Japan, and Russia. However after several rounds of discussions, talks broke down yielding no results.

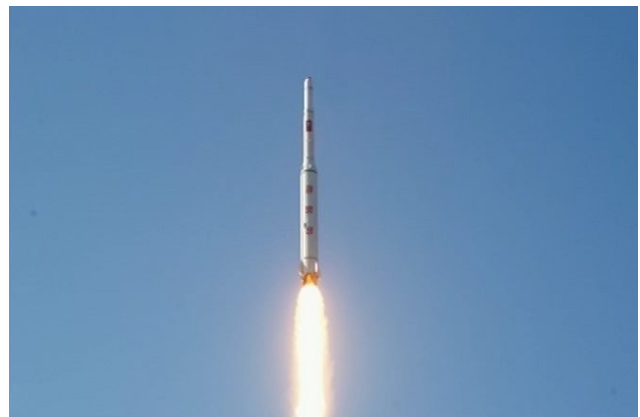
Efforts to address North Korea's ballistic missile program have been similarly frustrated by Pyongyang's unwillingness to cooperate with the international community. North Korea has refused to participate in the Missile Technology Control Regime, a voluntary arrangement among member nations who are committed to controlling the spread of missile technology. North Korea is a willful proliferator of ballistic missile technology and has provided full systems, components, technology and expertise to countries in the Middle East, South Asia, and North Africa. The United Nations Security Council

has adopted a number of resolutions in response to work on North Korea's nuclear and ballistic missile program. Resolution 2087 condemns Pyongyang's December 2012 launch and prohibited further work on the technology.

In addition to its provocative work toward developing a nuclear program, Pyongyang issues regular threats against the United States and its neighbors in the region. Since the 1990s, North Korea has consistently threatened South Korea, the United States, and U.S. forces in the Pacific with nuclear attack. Until recently, most of Pyongyang's threats have been indirect and do not overtly mention the use of nuclear weapons. In 1994, a negotiator from the DPRK threatened to turn South Korea into a "sea of fire," a phrase that has been repeated several times since. In 2002, Pyongyang claimed it would "mercilessly wipe out the aggressors" after U.S. President George W. Bush declared that North Korea was part of the "axis of evil." In 2012, the DPRK threatened a "merciless and sacred war" with South Korea. In 2015, Pyongyang issued a direct nuclear threat when a director of the North Korean Atomic Energy Institute claimed, "If the U.S. and other hostile forces persistently seek their reckless hostile policy towards the DPRK and behave mischievously, the DPRK is ready to cope with them with nuclear weapons any time."



Kim Jong-un observes February 2016 missile launch



DPRK February 2016 Rocket Launch considered a success

NORTH KOREA'S BALLISTIC MISSILE ARSENAL

North Korea's efforts to develop ballistic missile capabilities date back to the Cold War, when the Soviet Union and China likely provided the isolationist nation with technical assistance. The DPRK's ballistic missile capabilities have progressed significantly over the last few decades, evolving from artillery rockets in the 1960s, to short- and medium-range ballistic missiles in the 1980s and 90s, and finally developing and testing intercontinental-range ballistic missiles in the late 1990s and 2000s. In 1965, North Korean leader Kim Il Sung chose to develop an indigenous ballistic missile capability, increasing the military budget and relying on outside assistance from the Soviet Union and China. As a result, the isolationist state was able to make rapid progress with its ballistic missile program by increasing funding for the program and reverse engineering the missiles of its Communist allies. In 1998, after an attempted satellite launch with a multi-stage missile, North Korea demonstrated a willingness to develop intercontinental ballistic missiles (ICBMs) that could target the United States homeland. North Korea continues to test and improve its ballistic missile capabilities and is an active proliferator of missile systems, components, and technology.

INTERCONTINENTAL-RANGE BALLISTIC MISSILES (ICBMS)

North Korea's known intercontinental-range ballistic missiles are the Taepodong series of missiles and the KN-08. The Taepodong-2/Paektusan-2 is a two to three-stage ballistic missile with an estimated range of 6,000 - 9,000 km and a payload capacity of 100 to 500 kg. The DPRK tested the Taepodong-2 in 2006, but the missile failed to perform to standards. Nonetheless, the Taepodong-2 is considered operational and has the capability to strike Alaska and the U.S. West Coast.

Recently, North Korea has developed and tested a three-stage version of the Taepodong-2 called the Unha that, according to Pyongyang, is a rocket designed to put a satellite into orbit. However, some experts speculate that the long-range rocket could be employed as a silo-based ICBM. If deployed as a ballistic missile, the Unha has a potential range of 10,000 km and is estimated to have a payload capacity of between 100 and 1,000 kg, meaning that the missile could be used to deliver a nuclear payload to targets in the central United States. The Unha has been tested four times: April 2009, April 2012, December 2012, and February 2016. The rocket failed to put a satellite into orbit during the first two tests, but was successful during the last two. Despite the true intentions of the Kim regime, the successful tests of the Unha rocket demonstrate a North Korean ability to develop a multi-stage ballistic missile capable of striking the U.S. homeland. In April 2012, during a parade to honor its founder, Kim Il Sung, the DPRK displayed a new ICBM known as the KN-08. The KN-08 is a road-mobile ICBM that has never been tested, but experts estimate that it has the potential to strike the continental United States with a nuclear payload. The road-mobile capability of the KN-08 and the corresponding increase in launch area uncertainty present a significant challenge for U.S. and allied missile defense forces.



Purported mock-up of KN-08



December 2012 Unha-3 Rocket Launch

INTERMEDIATE-RANGE BALLISTIC MISSILES (IRBMS)

Pyongyang is believed to have two types of intermediate-range ballistic missiles (IRBMs): the Taepodong-1 and the Musudan. The Taepodong-1 was North Korea's first multi-stage ballistic missile and is currently operational and deployed. The IRBM has an estimated range of 2,200 km and a payload capacity between 100 and 200 kg. Satellite photographs of the Taepodong-1 have caused experts to speculate that the intermediate-range missile has two stages: the first stage consists of components from the medium-range Nodong missile and the second stage is made up of components from the short-range Hwasong-6 missile. In 1998, a three-stage mod of the Taepodong-1 was tested in an attempt to put a satellite into low earth orbit. During the test, the first two stages worked correctly, however, the third stage malfunctioned and the test was a failure. The DPRK's other IRBM is the Musudan. The Musudan—also known as the Nodong-B or the Taepodong-X—has a speculated range of 2,500 to 4,000 km and an estimated payload capacity of 1,200 kg. The likely targets of the Musudan missile are U.S. bases in the Pacific, Okinawa, and Japan. Little is known about the Musudan, but it is likely that the IRBM is not yet operational and still in the developmental phase. U.S. sources estimate that North Korea has fewer than 50 Musudan and Taepodong-1 IRBM missiles. IRBMs fired from North Korea can target South Korea and Japan along with U.S. military bases in the Pacific.

MEDIUM-RANGE BALLISTIC MISSILES (MRBMS)

The Nodong missile, which Pyongyang began developing in the late 1980s based on the scud design, has an estimated range of 1,350-1,600 km and payload capacity of about 1000 kg. U.S. sources estimate that the DPRK has around 200 deployed Nodong missiles. Japan is the likely target of the Nodong, however, it is believed that the medium-range ballistic missile (MRBM) is relatively inaccurate, having a "circular error probable" of 2 to 4 km. The Nodong is assumed operational, and it is believed that the MRBM was tested in 2006, 2009, and 2014. North Korea's Nodong MRBM could potentially be used to strike anywhere in South Korea or parts of southern Japan.

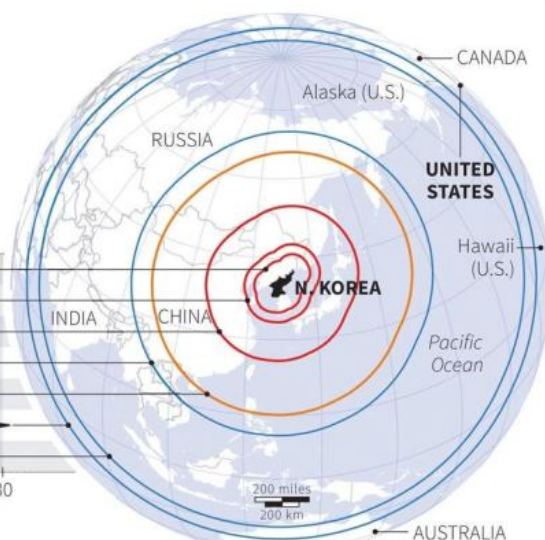
North Korean missile range

North Korea fired four short-range missiles toward the sea off the country's east coast on Thursday, a media official at South Korea's Defence Ministry said.

MISSILE CAPABILITIES — North Korea's estimated ballistic missile ranges

STATUS: ■ Operational ■ Flight tested ■ In development/untested

	Origin	Warhead (kg)	Range (km)	Length (m)
■ Hwasong-5	Russia	1,000	300	10
■ Hwasong-6	Russia	700	500	10
■ Rodong	N. Korea	700	1,300	20
■ Musudan	Russia	650	3,000+	30
■ Taepodong-1	N. Korea	500	2,500	30
■ Taepodong-2	N. Korea	700-1,000	6,700	30
■ KN-08 (Nodong C)	N. Korea	750-1,000	6,000	30



Sources: Federation of American Scientists; Global Security; Center for Nonproliferation Studies; South Korean defence ministry.

Staff, 27/02/2014

REUTERS

SHORT RANGE BALLISTIC MISSILES (SRBMS)

The Kim regime possesses a variety of short-range ballistic missiles (SRBMs) and the U.S. estimates that North Korea deploys over 600 Scud missile variants. Specifically, the isolationist state may currently employ three types of SRBMs: the KN-02, the Hwasong-5, and the Hwasong-6. The KN-02 has a range of up to 120 km and is operational, putting military installations in South Korea at risk. Moreover, the KN-02 is believed to have a payload capacity between 250 and 500 kg. Other SRBMs employed by North Korea are the Hwasong-5 and the Hwasong-6, both of which were developed with Soviet assistance in the 1970s and 80s and are speculated to have been tested and deployed. The Hwasong-5—also known as the Scud-B—has a range of 300 km and the Hwasong-6—also known as the Scud-C—has a range of 500 km. It is believed that Pyongyang sold the Hwasong-6 to Iran, where it is known as the Shehab 2. Both of the Hwasong SRBMs may be capable of delivering biological, chemical, or nuclear payloads and striking anywhere in South Korea and small parts of southern Japan.



North Korean Short Range Ballistic Missile Test

SUBMARINE LAUNCHED BALLISTIC MISSILES (SLBMS)

The DPRK's submarine-launched ballistic missile (SLBM) is the KN-11—also known as the Polaris-1—and is still in the testing phase. The range and payload capacity specifications of the KN-11 are unknown, however, the SLBM is believed to be comparable to the Soviet single-stage liquid-fueled R-27 that has a range of 2,400 km and a 650 kg payload. In early 2016, state media footage released by North Korea showed the testing of an SLBM—likely the KN-11—however, the tests are reported to have been unsuccessful. To complement its developing SLBM program, North Korea is also working on deploying a submarine capable of launching ballistic missiles. Currently, North Korea is in the process of reverse engineering a Soviet-era Golf-II class submarine, which, although obsolete by modern standards, has the capability to launch nuclear-armed ballistic missiles. While reports indicate that some North Korean test SLBMs were

launched from submersible vessels, the Kim regime is likely years away from developing any operational ballistic missile submarines. Moreover, if a fleet of submarines are developed based on the Golf-II design, it is likely that they will be outdated and easily detectable by more advanced submarine hunting equipment.

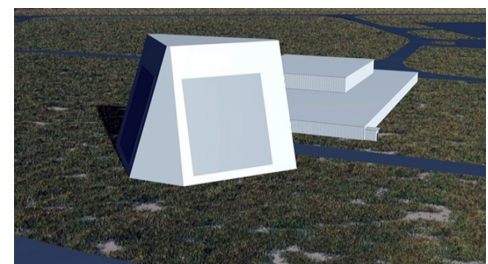
CRUISE MISSILES

In the summer of 2014, North Korea released footage showing the launch of a cruise missile appearing to be a variant of Russia's Kh-35 anti-ship cruise missile. If similar to the Russian Kh-35, Pyongyang's cruise missile variant has a range of about 130-140 km and travels at high speeds near the sea's surface. This sea-skimming cruise missile threatens U.S. and allied naval forces in the region, including the American and Japanese Aegis missile defense vessels.

ADDRESSING THE THREAT***United States***

The United States deploys a variety of sensors and missile interceptors to defend against short, medium and intercontinental-range ballistic missiles. A particularly important element of the BMD system is the ground-based interceptors (GBI) deployed in Alaska and California as part of the Ground-based Midcourse Defense system (GMD). GMD is the only system capable of defending the homeland against long-range ballistic missile threats from North Korea and employs sensors and interceptors designed to track, engage, and destroy intermediate and long-range ballistic missile threats. The U.S. currently deploys 30 GBIs in California and Alaska, each equipped with an Exoatmospheric Kill Vehicle (EKV) that serves as the intercept component of the GBI. The EKV is currently being updated as the Redesigned Kill Vehicle (RKV) to meet the growing threat posed by North Korea. RKV is the next-generation kill vehicle designed for increased reliability, ease of assembly, enhanced performance and decreased cost. The U.S. is also developing a Multi-Object Kill Vehicle (MOKV) that will be able to target and destroy several objects in space using advanced sensors, guidance systems, and propulsion and communication technologies. In addition to modernizations of the kill vehicles, the U.S. is also improving the radar and sensors used as part of the Ballistic Missile Defense System. The Long Range Discrimination Radar (LRDR), currently in development, is a high-powered S-band radar with the ability to acquire, track, and discriminate ballistic missile threats. LRDR will better distinguish between warheads, decoys, and debris. Improved discrimination and tracking data provided by the LRDR increases the effectiveness of GBIs and reduces the number of interceptors needed to counter ICBMs.

While the United States deploys multiple defense systems to protect the mainland, Hawaii currently does not benefit from these redundancies and is protected only by the GBIs deployed in Fort Greely, Alaska and Vandenberg AFB, California. In light of North Korea's fourth nuclear tests in January 2016 and its continuing development of ballistic missiles that can strike Hawaii and the mainland United States, the U.S. is considering adding to its missile defense network in the Pacific. Specifically, U.S. officials are considering transforming the Aegis Ashore test site in Hawaii into a combat-ready facility that would add an extra layer of protection for the island and the U.S. West coast.



Long Range Discrimination Radar Concept Art



Top: GBI being lowered into its silo

Bottom: MOKV Concept Art



The Pacific Missile Range Facility in Hawaii is home to an Aegis Ashore test complex

U.S. Territories

The U.S. Territory of Guam is a little over 3,400 km from North Korea, putting it within range of Pyongyang's medium and intermediate-range ballistic missiles. To counter the threat, the United States deployed a Terminal High Altitude Area Defense (THAAD) battery to Guam in April 2013 following North Korea's third nuclear test. The THAAD battery, which is now permanently stationed in Guam, works with Aegis BMD ships in the Pacific to provide the island with a layered defense. The need to protect Guam from the threat posed by North Korea is great given Guam's strategic importance in the Pacific. Guam is home to Anderson Air Force Base and Naval Base Guam, which allow the United States to maintain military force readiness in the region. On several occasions, the U.S. deployed nuclear-equipped B-52 bombers from Anderson AFB to fly over South Korea in a show of support and deterrence following North Korea's nuclear tests in 2013 and 2016. Naval Base Guam is also a homeport for four fast-attack submarines that deploy throughout the Pacific. The ability to defend Guam and the U.S. forces there from North Korean ballistic missiles would be especially important during times of crisis when the U.S. needs to protect the people and weapons stationed there to be able to retaliate and protect other deployed forces.



Terminal High Altitude Area Defense system launches an interceptor



Test of the Terminal High Altitude Area Defense system



South Korea and Japan

While North Korea poses a significant threat to the U.S. homeland and U.S. territories in the Pacific, the threat is even greater for U.S. allies in the region such as South Korea and Japan. South Korea's capital, Seoul, a city of just over 10 million, is just 35 miles from the border with North Korea and the entire country is within range of North Korea's short-range and medium-range ballistic missiles. South Korea is also vulnerable to the North's use of weapons of mass destruction, which includes chemical, biological, and nuclear weapons.

To counter the North Korean threat, South Korea has hosted missile defense systems since the United States stationed the 1st Battalion, 43rd Air Defense Artillery in the ROK in 1994 in response to North Korea's threats to suspend the armistice on the Korean Peninsula. South Korea develops and upgrades its defenses in response to North Korean provocations and technological developments. In response to North Korea's 2006 nuclear test, South Korea announced it would create its own indigenous missile defense system, the Korean Air and Missile Defense System (KAMD). In May 2007, the ROK Navy launched the *Sejong the Great* (DDG 991), its first Aegis-equipped guided missile destroyer. The ROK commissioned two more ships in November 2007 and June 2011. All three ships were produced jointly by the United States and South Korea.

Currently, South Korea deploys Patriot PAC-2 and PAC-3 batteries, Israeli-made Green Pine land-based radar systems, and three KDX-III Class Aegis Destroyers equipped with SPY-1D(V) radar. The DPRK's latest nuclear test in January 2016 reignited the debate in South Korea over the deployment of the THAAD system. South Korea's deployment of THAAD would provide the ROK with a layered and reliable missile defense system to counter against short, medium, and some intermediate-range ballistic missiles launched by North Korea. The United States has sought to deploy THAAD in South Korea for a number of years, but South Korea showed reluctance given China's opposition to improved missile defense on the Korean Peninsula. China's opposition is due in part to the radar system used by THAAD to detect missiles, which has a coverage area that includes large portions of mainland China and could monitor Chinese missile activities.

Like South Korea, Japan is within range of North Korea's medium and intermediate-range ballistic missiles and its investment in missile defense is fueled by the erratic behavior and technological developments of the Kim regime. Japan and the United States have a long history of cooperation in the realm of ballistic missile defense and the two countries collaborate to research, develop, and deploy missile defense systems. In 1998, North Korea launched a Taepodong-1 missile that flew over Japan before landing in the Pacific Ocean. This test and subsequent missile and nuclear weapons tests reignited Japan's interest in deploying missile defense systems. Japan deploys a layered defense system consisting of Kongo-class Aegis destroyers, Patriot PAC-3 batteries, and AN/TPY-2 radar systems to protect the country from a myriad of North Korean threats including Nodong and Musudan missiles. Japan is also considering the deployment of THAAD to protect against the North Korea threat.

Pyongyang's improving nuclear and ballistic missile capabilities pose a significant threat to South Korea, Japan, and the United States. To counter this growing North Korean threat, these nations have chosen to deploy integrated missile defense systems, building cooperation and trust with one another in the process. As the DPRK continues to develop its nuclear and ballistic missile capabilities, this cooperation, sharing of information, and deployment of integrated missile defense systems will become even more important.

ABOUT MDAA

MDAA's mission is to make the world safer by advocating for the development and deployment of missile defense systems to defend the United States, its armed forces and its allies against missile threats. We are a non-partisan membership-based and membership-funded organization that does not advocate on behalf of any specific system, technology, architecture or entity.