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North Korea and Its Missile Program – All What You Need to Know

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Global Research, November 19, 2017
South Front 18 November 2017

Region: Asia
Theme: Intelligence, Militarization and WMD
In-depth Report: NORTH KOREA

One may say that the political and military situation in the Asian Pacific is a calm before the storm. The race to prepare everyone to an armed conflict between the "free world" and the "communist totalitarian regime" in Pyongyang that was propagated by the western media has reached its peak.

The US are concentrating their forces in Southeast Asia in order to strike at the military and industrial objects in North Korea. Three carrier strike groups (CSG) are awaiting orders in the Sea of Japan: USS CVN-68 Nimitz, USS CVN-71 Theodore Roosevelt and USS CVN-76 Ronald Reagan. They are accompanied by three air wings. That comes up to 72-108 F/A-18E jets with 36 older F/A-18C Hornet jets for Navy support. The CSGs include up to 18 Arleigh Burke guided missile destroyers, with 540 Tomahawk Land Attack Missiles. The Sea of Japan is also being patrolled by USS Michigan (SSGN-727) and USS Florida (SSGN-728) cruise missile submarines, with 300 more Tomahawks. There are six B-1B and B-52 bombers with three nuclear-capable B-2 bombers at the Andersen Air Force Base (AFB) in Guam. All of this striking power is mobilized not only for show.

A real threat of a US nuclear strike reemerged during the Korean war of 1950-1953. The US developed several plans to bomb key objects in North Korea in order to gain a strategic advantage. The top brass did not bring themselves to open the Pandora's box, but the threat of nuclear obliteration was still present even after the war, although to a lesser extent. Quite possibly this was what spurned **Kim Il-sung** to start a nuclear program of his own.

Independence tests

In the 60s the initial developments were aided by the Soviets, and later on with the help of the Chinese. Pakistan played a crucial role in the program. In the late 90s **Abdul Qadeer Khan** — "the father of Islamabad's nuclear bomb" — handed over to North Korea the uranium enrichment equipment, five thousands centrifuges and the necessary documentation. Khan attracted the public eye after stealing centrifuge projects when working in the Netherlands back in the 70s. According to US intelligence officials, he exchanged the compact disks with key data for missile technologies. In 2005 **President Pervez Musharraf** and **Prime Minister Shaukat Aziz** admitted that Khan supplied North Korea with the centrifuges. In May of 2008 the scientist that had previously claimed of making the exchange by his own volition went back on his word and said that Pakistan's government had made him a fall guy. He also claimed that the North Korean nuclear program was already way on its way before he visited.

In the early 80s all of the best physicists in the country were gathered in Yongbyon Nuclear Scientific Research Center about a hundred kilometres to the north of Pyongyang. With the help from the Chinese, an experimental 20 MW light water graphite reactor was built there on August 14, 1985. It had been working until 1989, when it was stopped because of the US pressure, with eight thousand fuel rods transported out of the active zone. The evaluations of how much plutonium North Korea generated differ. The US State Department evaluates the amount of plutonium to be from six to eight kilograms, CIA claims it was nine kilograms. According to Russian and Japanese experts eight thousand fuel rods would generate no less than 24 kilograms of plutonium. North Korea managed to reactivate the reactor later: it was working since 1990 till 1994, when it once again stopped because of the US pressure.

On March 12, 1993 Pyongyang stated that it plans of removing itself from the Treaty on the Nonproliferation of Nuclear Weapons, and refused to grant IAEA access to its objects.

From 1990 till 1994 two more Magnox reactors were built (50 MW and 200 MW) in Yongbyon and Taechon. The former is capable of producing 60 kilograms of plutonium per year, which would be sufficient for 10 nuclear charges. The 200 MW reactor is capable of producing 220 kilograms of plutonium, enough for 40 nukes. Following the UN Security Council Resolution 825 and the threat of US air strikes, North Korea succumbed to the diplomatic pressure and put a stop to its plutonium program. After the suspension of the agreement in the late 2002 Pyongyang reloaded the reactors.

On October 9, 2006 North Korea demonstrated its nuclear capability with an underground test. The explosion had a yield of 0.2-1 kiloton.

On May 25, 2009 North Korea conducted a second underground test. US Geological Survey (USGS) reported that the explosions had a higher yield, estimated from two to seven kiloton.

On February 12, 2013 North Korean central news agency stated that a small nuclear charge with a high yield was tested. South Korean Institute of Geoscience and Mineral Resources reported that the yield was estimated to be in range of 7.7-7.8 kiloton.

On September 9, 2016 an earthquake vibrations with an amplitude of 5.3 were registered at 9.30 AM local time. The epicenter was in 20 km from Punggye-ri test site. USGS designated the vibrations a nuclear explosion. North Korea later officially stated that it had conducted its fifth nuclear test. The yield was estimated at from 10 to 30 kiloton.

On January 8, 2017 the first thermonuclear charge device tested was conducted in North Korea. Chinese seismologists registered a strong earthquake. North Korea was confirmed to have a hydrogen bomb in possession last September. Seismologists of various countries estimated the amplitude to be 6.1-6.4, with the seismic center being near ground level. North Korean officials claimed that they have successfully detonated a thermonuclear charge. The yield was estimated to be from 100 to 250 kiloton.

On August 8, 2017 The Washington Post reported that according to US Defense Intelligence Agency North Korea has manufactured up to 60 small thermonuclear warheads which could be mounted on cruise and ballistic missiles. Many western media outlets published photos that demonstrated that Pyongyang was in possession of a 500-650 thermonuclear warhead.

Despite all the efforts in the realm of missile defense during the last 60 years, the media

published a lot of expert opinions uncertain of an effective countermeasure against medium-range and intercontinental ballistic missiles. A strategic ballistic missile with a nuclear warhead is an ace in a military deck, an ace many countries desires to have in the political games at the international table.

But mounting a nuclear warhead on a ballistic missile is a difficult task. All five members of the "nuclear club" went a long and difficult way from testing a nuclear bomb to mounting it on a missile. It took seven years since the first US nuclear test to mount a 1200 kg nuclear W-5 warhead onto Matador MGM-1 and Regulus-1 cruise missiles, and it took almost nine years to create W-7 warheads for tactical ballistic missiles Honest John M-3 and Corporal. 30 nuclear tests were conducted during this time period. Some of them were conducted in order to improve the mass and size of the bombs. The W-3's 10,300 pound explosive device was reduced to W-7's 1645 pound one, with the diameter shrinking from 60 inches to 30 inches respectively.

The second important task was adapting the warhead to high speeds and temperatures that happen during ballistic flight. The first Soviet medium-range ballistic missile, the R-5M (SS-3), with a mounted nuclear warhead was tested in February of 1956. The mounted RDS-4 nuclear bomb had a payload of 1,300 kg. By that time the Soviet Union had conducted 10 nuclear tests. China had had four nuclear tests by the time the DF2 medium-ranged ballistic missile was flight tested.

Starting with Mk-1 Little Boy and Mk-3 Fat Man, all nuclear bombs are divided in two types. The first type bombs are the so-called Gun-type fission weapons, with Mk-1 being the "father" of the method. Their fissile material is assembled into a supercritical mass by the use of the "gun" method: shooting one piece of sub-critical material into another. The only fitting active material for this is uranium with a high percentage of U-235. The second type is implosion, with Mk-3 acting as prototype: a fissile mass of either material (U-235, Pu-239, or a combination) is surrounded by high explosives that compress the mass, resulting in criticality. Pu239, U233 and U235 may be used as the active material in this case. The former type is simpler to manufacture and therefore more easily available to less scientifically developed countries. The latter type requires less active material, but is considerably more difficult to build and requires advanced technologies. The implosive type devices are made of concentric hollow spheres. The first sphere is made out of the active material (with outer radius of 7 cm in case of U235, 5 cm for Pu239 and internal radius of 5.77 and 4.25 respectively). The second 2 cm thick sphere is made out of beryllium that deflects the neutrons. The third one is a 3 cm sphere made out of U238. The fourth sphere from 1 to 10 cm thick is a regular explosive. The device is covered with couple cm of aluminium. The model did not change much since the Fat Man, except for the obsolete explosive itself — Amatol that weighed 2,300 kg. Nowadays the warheads use PBX — 9501 (W-88), six to eight kg of which proves sufficient. IN 1959 US Atomic Energy Commision developed a universal mathematical model for nuclear and thermonuclear implosive device as a prime module. It is obsolete for contemporary Russian and American devices, but evaluating North Korean ones would be fitting. This model allows to estimate the power of a nuclear device if we know its diameter. 12' device would have a 10 kiloton yield, 16' would have 25, 18' would have 100 and 24' would be one megaton. The length of the device corresponds with its diameter in the ratio of 5 to 1, i.e. if the device is 12', it's length is 60", and weight is 500 lb.

All Hwasongs represented

Hwasong-5 is a complete copy of the Soviet R-17 Elbrus (Scud-C) missile. North Korea got its hands on them from Egypt by helping them in Yom-Kippur wars during 1979-1980. As relations with the Soviet Union were strained, and the Chinese were unreliable, North Koreans started reverse engineering "Egyptian" R-17. The process was accompanied by building a manufacturing industry, with main effort centered on factory #125 in Pyongyang, Sanum-dong research institute and Musudan-ri launching site.

The first prototypes were developed in 1984. Named Hwasong-5 (designated by the West as Scud Mod. A) the missiles were identical to R-17 received from Egypt. The test flights were conducted in April of 1984, but the first batch was limited because they were only planned for test flights, as a way to ascertain the quality of manufacturing. Mass production of Hwasong-5 (Scud Mod. B) began in 1985. This type had a few improvements over the original Soviet project. The range with a 1,000 kg warhead mounted was improved from 280 to 320 km, and the Isayev engine was slightly modernised. There are several types of payloads: high-explosive fragmenting, chemical and possible biological. During the whole production cycle, until Hwasong-6 was developed in 1989, several upgrades are suspected to have been implemented, but there is no exact data available. In 1985 Iran bought 90-100 Hwasong 5 for $500 million. The deal included the production technology, which helped Tehran establish its own production. The missile was named Shahab-1 in Iran. United Arab Emirates bought a batch of Hwasong-5 missiles in 1989.

Hwasong-6 is an upgrade to the forerunner. It has longer range and is more accurate. It entered mass production in 1990. Approximately one thousand missiles had been made by 2000, 400 of which were sold for from $1.5 to $2 million. 60 missiles were delivered to Iran, where they got named Shahab-2. They were also exported to Syria, Egypt, Libya and Yemen.

Hwasong-7 (No Dong) is a medium ranged ballistic missile, which started active use by North Korea in 1998. According to the western experts, it has an operating range of from 1350 to 1600 km and capable of delivering payloads from 760 to 1,000 kg. No Dong was created by North Korean engineers, western experts stipulate, with financial backing from Iran and technical help from Russia. Apparently during the chaos and the economic collapse of the 90s, Russian defence contractors began selling new technologies to all interested parties. It is stipulated that Makeyev Rocket Design Bureau transferred the R-27 Zyb and R-29 Vysota to North Korea. The 4D10 engine, according to the US, served as prototype for No Dong. This is questionable. there is nothing out of the ordinary in the fact that No Dong and R-27 share some technical characteristics, as at least a dozen US, Japanese and European Missiles are also really similar. According to the US Intelligence, the missile is powered by a liquid-propellant rocket with TM 185 fuel (20% petrol, 80% kerosene), with AK-271 oxidizer (27% N_2O_4 + 73% HNO_3). Its pulling power is 26,600 kg (in a vacuum). But 4D10 engines that had been made 50 years ago used a more sophisticated fuel, UDMH, with 100% N_2O_4 as oxidizer. The time of flight of No Dong while active is 115.23 seconds. Maximum speed is 3750 meters per second. It weighs 15,850 kg, with a separated part during flight weighing 557.73 kg. There are export variations for Pakistan and Iraq. The time of flight depends on range, which depends on the weight of the warhead. A flight for 1,100 km with a 760 kg warhead will take 9 minutes 58 seconds. A flight for 1,500 km with a 557.73 kg warhead will take 12 minutes. This was measured by the US satellites during the test launches from North Korea, Pakistan and Iran.

Hwasong-10 (BM-25 or Musudan) – mobile intermediate range ballistic missile system. It was shown for the first time at a military parade dedicated to 65th anniversary of Workers' Party

of Korea on October 10, 2010, although if western experts are to be believed those were mock-up models. Hwasong-10 looks like a Soviet P-27 Zyb SLBM, but it's 2 meters longer. According to calculations, thanks to elongating the fuel tanks the range may reach 3200-4000 km as opposed to 2500 of the Soviet prototype. Since April of 2016 Hwasong-10 has been tested a number of times, with two tests, as it seems, successful. North Korea's inventory is about 50 launchers. With assumed range of 3200 km Musudan is capable of hitting any target in Eastern Asia, including US military bases on Guam and Okinawa. North Korea sold a version of this missile to Iran under the BM-25 moniker. The index reflects the active range (2500 km). Iran designated the missile Khorramshahr. The missile carries 1800 kg of payload for 2000 km (Iran claims that it had deliberately lowered the range to one like a cruise and ballistic missile would have in order to comply with the internal laws). This range is enough to hit not only Israel, Egypt and Saudi Arabia, but also NATO members: Romania, Bulgaria and Greece. According to Tehran, the missile may carry several warheads, most likely MRV.

Hwasong-12, judging from the photos of an experimental launch on May 14, 2017, is a project of a single-stage missile with starting weight of 28 tonnes, powered by four micro liquid-propellant rockets. According to first evaluations, Hwasong-12 will have a maximum range of 3700 to 6000 km. Hwasong-12 was mounted on Chinese-made Wanshan Special Vehicle WS51200 at a military parade in April of 2017. It is likely to replace the unreliable Hwasong-10.

Hwasong-13 (KN-08 No Dong-C) is an ICBM. For some time it was considered an intermediate range missile. The engine tests for the new missile were reported by western observers in the late 2011. The KN-08 system was first demonstrated at a parade in Pyongyang on April 15, 2012. The missiles were equipped with mock-up warheads. Some people speculate that the missiles themselves were mock-ups, as there are doubts whether it's possible to transport liquid-propellant rockets of such size without a container due to high probability of mechanical deformation of the shell. Another design of KN-08, although similar, was shown at the parade dedicated to 70th anniversary of North Korea on October 10, 2015. It is possible, that in 2012 fake slightly different mock-ups were shown in order to misinform, and in 2015 real missiles were shown. The system is mounted on Chinese WS51200 vehicle.

Hwasong-14 is the newest development. It's a fully fledged ICBM that's being finished now, and is being prepared to test launches. It's designated by NATO as KN-20. It was first shown at a military parade in 2011, but the first test launch was conducted on July 4, 2017. It was fired with apogee of 2802 km, landing 933 km away in the Sea of Japan. According to international classifications it is an ICBM, as its apogee was higher than 1,000 km and distance was 5,500 km. According to analysts, Hwasong-14's range is estimated to be 6,800 km. It is able to reach Alaska and continental US territory. A second test launch was conducted on July 28, 2017. Fired on a lofted trajectory with apogee of 3,724.9 km, it landed 998 km away in the Sea of Japan. Total flight time was 47 minutes, 12 seconds. According to Russia. Hypothetically such a missile would be able to hit targets in 10,700 km range, making it capable of hitting any target on the US West Coast. Taking Earth rotation into account, Chicago and possibly New-York are in range. The New York Time suggested that Hwasong-14 engines were prototyped from Ukrainian-made RD-250s. Yuzhmash allegedly handed them over to North Korea. US expert Michael Elleman says that constructor documentation was also bought with some of the engines. According to South Korean intelligence, Pyongyang received from 20 to 40 RD-251 from Ukraine. Kiev denies supplying

the engines to North Korea. Joshua Pollak, editor-in-chief The Nonproliferation Review notes that the RD-250 data leak from Ukraine is highly possible, but the first stage of Hwasong-14 was likely developed in cooperation with Iran. Even if North Korea had access to technical documentation or actual 4D10, 4D75 or RD-250 missiles, using them is out of question for Pyongyang. The fact is that North Korea's chemical production is very weak, and it would be unable to produce one of the heptyl fuel components (unsymmetrical dimethylhydrazine UDMH). Pyongyang would have to buy it from Russia or China, which is impossible due to embargoes. North Koreans used a well known trick — they just enlarged the Isayev 9D21 engine to accommodate the power necessary.

Pukguksong-2 (KN-15) is a cold launching solid fuel intermediate-range ballistic missile. It is a ground launched variant of KN-11 SLBM. Its first test flight was on February 12, 2017, despite North Korea testing the KN-11 submarine-launched variant since May 2015. Not much is known about KN-15's capabilities. In February of 2017 the missile reached an altitude of 550 km and flew a distance of about 500 km, which is almost identical to successful tests of KN-11 in August of 2016. This deformed nonoptimal trajectory give reason to claim that KN-15 i capable of hitting targets in range from 1200 to 2000 km. Solid fuel engine allows for firing the missile right after receiving an order. Such missiles require less auxiliary transport and personnel, which allows its operational flexibility. Currently the only operable ballistic missile in North Korea is KH-02. One of the new things is launching the missile from a transport erector launcher (TEL). This is clearly influenced by Russian technologies. The TEL is made out of thick steel, which allows using the container multiple times. The KN-15 tests are notable because they were conducted by using crawler-tracked launcher platform that looked like old Soviet 2P19 on ISU-152. This differentiates KN-15 from other North Korean missile systems, which used wheeled platforms and therefore are limited to roads. Getting the system on crawler-tracks allows for flexibility that is much needed in North Korea, as it only has about 700 km of asphalted roads.

The launcher is assumed to be based on T-55 tank. This shows that North Korea is capable of developing launchers on its own since it is unable to buy them from Russia and China due to weapon embargoes. KN-15 was also considered similar to JL-1 and DF-21, which raises the possibility that it was made based on Chinese technology. Their shapes are similar, and the speed of KN-15's development also raises suspicion. Physical similarities are an unreliable method to discern the origin of a missile, considering overall physical similarities between SLBMs and solid fuel missiles.

On May 21, 2017, North Korea conducted a second successful KN-15 test launch. The missile flew a distance of 500 km, reached an altitude of 550 km and landed in sea. The missile's similarities to US SLBM Polaris A-1 became apparent. Mass and size were almost the same: the missiles in diameter were 1.4m and 1.37 m, in length 9.525 m and 8.7 m respectively. The starting weight of KN-11/15 is probably close to Polaris A-1 too, which is 13,100 kg. But the North Korean missile is a more complete and modern product. The stages of KN-11/15 are made out of composite in cocoon-like manner, while Polaris A-1's stages are made out of AM3-256 vanadium steel.

North Korea is a tough nut to crack. Try not to hurt your teeth, imperialists.

Originally appeared in Russian at VPK-NEWS

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