

# ISSUE BRIEF

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## North Korea's Ballistic Missile Program

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August 2015

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## **Introduction**

The United States and its East Asian allies consider North Korea's development and proliferation of ballistic missiles to be a major security threat and source of regional instability. Since Kim Jong Un assumed power, North Korea has demonstrated a renewed focus in advancing these capabilities. The DPRK has deployed an estimated 700 short-range ballistic missiles (SRBMs) capable of striking most of South Korea, 200 Nodong medium-range ballistic missiles (MRBMs) that threaten Japan, and up to 100 Musudan intermediate-range ballistic missiles (IRBMs).<sup>1</sup> Pyongyang has also developed two intercontinental ballistic missiles (ICBMs): the Taepodong-2, tests of which have triggered strong international reaction, and the road-mobile KN-08 missile, which has not been flight-tested.<sup>2</sup> However, the extent to which these ICBMs are currently deployed or operational remains difficult to determine.

Much of the open source information about North Korea's missile program – including its capabilities, historical development, and underlying strategic doctrine – remains inconclusive. One key question is the reliability and accuracy of the missiles North Korea has deployed, because the DPRK has not rigorously tested some of its missiles to the same extent that most countries with ballistic missile programs have.<sup>3</sup> Another question is the scope and nature of foreign involvement in North Korea's development of ballistic missile capabilities and the extent of North Korean missile proliferation to foreign countries. Finally, the two most crucial unanswered questions from the U.S. perspective are whether North Korea has the technical capacity to miniaturize a nuclear warhead to fit on its missiles, and whether Pyongyang is able to deploy an ICBM that could successfully strike the continental United States.

The U.S. and the international community have responded to developments in North Korea's missile program through sanctions, direct negotiations, and interdictions of its missile exports. While these efforts may have constrained the growth of North Korea's missile program, they have not prevented the DPRK from gradually improving and expanding its ballistic missile capabilities. In recent years, there appears to have been renewed emphasis on developing these capabilities: North Korea engaged in extensive short-range missile test exercises throughout 2014, unveiled a developing submarine-launched ballistic missile (SLBM) capability in May 2015, and has promised "a variety of satellites and long-range rockets which will be launched by the DPRK one after another" in the future.<sup>4</sup>

## **The Early Development of North Korea's Missile Program**

According to most open source literature, North Korea received its first ballistic missile system, the Soviet Scud-B, from Egypt sometime in the late 1970s or early 1980s.<sup>5</sup> By the mid-1980s, North Korea successfully reverse-engineered the Scud-B to serve as the basis for indigenously producing its own Hwasong-5, which it also exported. By the end of the decade, North Korea also began producing the longer-range Hwasong-6 missile – a variant of the Scud-C – and in 1990 first tested the Nodong, a medium-range ballistic missile based on Scud technology.<sup>6</sup> The Nodong is believed to be the basis for Iran's Shahab-3 missile and Pakistan's Ghauri missile,

with Iran assisting in its development and Pakistan purchasing the missile in the early 1990s.<sup>7</sup> Other parties, such as Soviet/Russian scientists (possibly without the approval of their government), may have assisted with the development of the Nodong, which would explain its relatively short development period.<sup>8</sup> Additionally, North Korea may have begun the development of its longer-range Taepodong -1 and -2 missiles during this period. It is believed that the initial design work for these multi-stage missiles could have begun in the late 1980s or early 1990s; Western analysts first identified them in 1994.<sup>9</sup>

Not party to any international agreements or organizations aimed at restricting the spread of ballistic missiles, such as the Missile Technology Control Regime, North Korea rose to prominence in the global arms market in conjunction with its development of missile technology during the 1980s. In addition to collaborating with Egypt in reverse-engineering the Scud-B, North Korea began selling missile technology to Iran – then in the midst of its “war of the cities” with Iraq – after 1985. According to one analyst, North Korea hit the peak of its foreign missile sales in the late 1980s and early 90s, primarily exporting to countries in the Middle East.<sup>10</sup> Numerous factors, including a drop in foreign demand, increasing indigenous missile-production capabilities among former buyers, and international pressure on recipient countries, may have contributed to a subsequent decline in North Korea’s missile sales abroad. However, even as the breadth of missile sales narrowed during this period, the degree of technical collaboration with countries including Iran, Syria, and Pakistan increased.<sup>11</sup> Many analysts believe that North Korean missile collaboration with Iran has been robust, but the current level of cooperation remains difficult to assess in the open source realm.<sup>12</sup>

### **U.S.-DPRK Missile Negotiations in the Agreed Framework Period**

Until Pyongyang’s launch of a long-range missile in 1998, U.S. concern over North Korea’s missile program was far outweighed by concern over its nuclear program. In 1992, Israel began talks with North Korea discussing the prospect of large-scale Israeli investment and technical assistance in exchange for North Korea ending its missile exports to the Middle East, but these negotiations ended inconclusively amidst U.S. opposition.<sup>13</sup> During the negotiations that led to the Agreed Framework, the U.S. warned North Korea that continued sale of missiles to Iran could undermine the possibility of improving U.S.-DPRK relations, but the final agreement did not directly mention ballistic missiles. Bilateral U.S.-DPRK missile negotiations that began in April 1996 collapsed the following year without making progress.<sup>14</sup>

In August 1998, North Korea launched a Taepodong-1 missile modified to be a space launch vehicle (SLV), its first test of a multi-stage missile. Although unsuccessful, the launch evoked international criticism, beginning a pattern that would continue with similar launches in 2009 and 2012. The stated purpose of these launches was to put a small satellite, the Kwangmyongsong, into orbit. However, this explanation was viewed by much of the international community as a veil for testing a long-range ballistic missile.

Several months afterwards, the U.S. resumed talks with North Korea regarding its missile program. Although the initial rounds of talks did not produce an outline for a comprehensive settlement, by September 1999 the DPRK agreed to a moratorium on long-range ballistic missile testing – but not foreign missile sales – so long as diplomatic talks continued.<sup>15</sup> The United States responded by relaxing some economic sanctions. Amid progress on missile negotiations and other issues in the waning days of the Clinton administration, Vice Marshal Jo Myong Rok visited the U.S. in October 2000, followed by a reciprocal visit by U.S. Secretary of State Madeleine Albright to Pyongyang.

The outline of the deal under consideration would have frozen the DPRK's development, production, testing, and deployment of missiles with a range over 500 km; halt North Korea's missile exports in exchange for "in-kind" compensation; provide North Korea with a few launches of civilian satellites annually; and take steps to improve U.S.-DPRK diplomatic relations. However, several key issues remained unresolved in these negotiations, including the extension of the freeze to include North Korea's Scud-type Hwasong missiles, the elimination of existing missiles, and verification and monitoring procedures. A contemplated visit from President Clinton to Pyongyang to finalize the agreement during the final months of his presidency did not move forward due to a lack of progress on these issues.<sup>16</sup>

The incoming Bush administration, skeptical of the Agreed Framework and the verifiability of a missile agreement, delayed the resumption of missile talks with the DPRK while it initiated a comprehensive policy review.<sup>17</sup> In response the North Korean government warned that it would be difficult for it to maintain the unilateral testing moratorium "indefinitely."<sup>18</sup> However, after Japanese Prime Minister Junichiro Koizumi's 2002 visit to Pyongyang, North Korea agreed to keep the moratorium in place, but continued to export missiles during this period.<sup>19</sup> A 2002 shipment of North Korean Scuds to Yemen – which was interdicted by the Spanish navy, but allowed to proceed due to the lack of international treaties governing the missile trade – prompted the creation of the Proliferation Security Initiative, a multilateral cooperative project aimed at interdicting the transfer of WMD.<sup>20</sup>

### **Additional Tests and International Sanctions**

In March 2005, a month after withdrawing from the Six Party Talks and declaring its production of nuclear weapons, North Korea announced that it had ended its moratorium on missile testing.<sup>21</sup> On July 5, 2006, the DPRK tested an array of ballistic missiles, including a long-range Taepodong-2. However, the missile failed after about 40 seconds of flight. Unlike other long-range missile tests, Pyongyang did not claim that this was an attempt to put a satellite into orbit. Ten days later, the UN Security Council adopted Resolution 1695, demanding that member states prohibit the procurement to or from the DPRK of "missile and missile-related items, materials, goods and technology." It also prohibited the transfer of "financial resources in relation to the DPRK's missile or WMD programmes."<sup>22</sup>

After the DPRK tested a nuclear device in October 2006, the UN adopted UNSCR 1718, which “Demands that the DPRK not conduct any further nuclear test or launch of a ballistic missile. . . suspend all activities related to its ballistic missile programme and in this context re-establish its pre-existing commitments to a moratorium on missile launching. . . [and] abandon all other existing weapons of mass destruction and ballistic missile programme in a complete, verifiable and irreversible manner.”<sup>23</sup> The resolution also introduced an array of sanctions intended to compel North Korea to return to the Six Party Talks and come into compliance with its denuclearization obligations.

On April 5, 2009, following the collapse of the Six Party Talks, the DPRK's Korean Central News Agency issued a statement saying that an Unha-2 space launch vehicle had been used to place a communications satellite into orbit. Western analysts identified the launch vehicle as a modified Taepodong-2, but doubted the reported success of the launch.<sup>24</sup> While the DPRK maintained that the launch was "a legitimate right of a sovereign state... to use space for peaceful purposes," the UN Security Council issued a Presidential Statement condemning it, calling it a “contravention” of UNSCR 1718 (2006) and applied additional sanctions. After North Korea conducted a second nuclear test the following month, the UN Security Council adopted Resolution 1874, which reiterated the call for North Korea to abandon its nuclear and missile programs, tightened sanctions, and called for states to interdict vessels believed to be involved in the transfer of prohibited goods.

On February 29, 2012, the United States and North Korea issued separate statements indicating that Pyongyang would freeze uranium enrichment and cease nuclear and missile testing, and in exchange Washington would provide North Korea with 240,000 tons of nutritional assistance. However, within two weeks of the agreement's announcement, North Korea announced plans to launch a satellite to commemorate the 100<sup>th</sup> birthday of Kim Il Sung.<sup>25</sup> Pyongyang claimed “the launch of the working satellite is an issue fundamentally different from that of a long-range missile” and did not violate the agreement, but Washington disagreed.<sup>26</sup> The subsequent launch rendered the “Leap Day Agreement” moot and the UN Security Council responded by issuing a Presidential Statement condemning it and sanctioning three additional North Korean entities. North Korea acknowledged that the launch was unsuccessful, and in response to the Presidential Statement said “many more satellites of the DPRK will be launched into space.”<sup>27</sup>

In December 2012, North Korea launched a second Unha-3 rocket from the same facility, this time successfully placing a satellite into orbit.<sup>28</sup> A multinational team of experts that examined salvaged parts of the Unha-3's first stage concluded that most of its components were made in North Korea.<sup>29</sup> The December launch renewed U.S. fears that North Korea would achieve an ICBM capability, with some analysts arguing that it represented a significant step forward in North Korea's ability to threaten the continental U.S.<sup>30</sup> Others noted that North Korea still needed to surpass significant technical hurdles before it could be considered to have a plausible nuclear ICBM capability. These analysts pointed to the need for the DPRK to miniaturize a nuclear warhead, develop a re-entry vehicle and accurate guidance system for its long-range missiles, and improve the reliability of these systems through more frequent testing.<sup>31</sup>

After the UN Security Council adopted a resolution condemning the launch and sanctioning additional entities, North Korea's National Defense Commission issued a statement pledging "a variety of satellites and long-range rockets which will be launched by the DPRK one after another and a nuclear test of higher level which will be carried out."<sup>32</sup> In February 2013, North Korea followed through on the latter part of this statement by conducting its third nuclear test. In turn, the UN Security Council adopted Resolution 2094, which expanded the scope of sanctions particularly in the financial sector. Following the test, some experts argued that North Korea could have miniaturized a nuclear weapon to mount atop a medium-range Nodong missile. However, this point remains disputed.<sup>33</sup>

Although North Korea has not launched a long-range missile or rocket since December 2012, it has continued to develop new capabilities and improve upon existing ones. 2014 was a particularly active year in terms of North Korean missile testing, with Pyongyang launching a variety of short- and medium-range missiles on 19 different occasions.<sup>34</sup> Pyongyang tested several new technologies within this timeframe, such as an extended-range KN-02 solid-fueled missile and an anti-ship cruise missile. In early 2015, North Korea also tested its first submarine-launched ballistic missile system in another demonstration of the regime's desire to expand its missile armaments.

### **New Technologies and Continuing Development**

Pyongyang's pursuit of ever-advancing missile technologies continues to raise concerns in the region. North Korea appears to have ambitious plans for developing new long-range missiles and has also begun deploying new cruise missiles, short-range tactical missiles, and unmanned aerial vehicles (UAVs).

In addition to the Taepodong-2, North Korea is developing several long-range missiles that could threaten the United States or its bases in the Pacific. Specific details regarding the capabilities and origins of the DPRK's intermediate-range Musudan remain unclear, but the system has been publicly displayed on two occasions despite having not been flight-tested.<sup>35</sup> Even less is known about the KN-08, a road-mobile ICBM that was first displayed at a military parade in April 2012. While a full-scale test flight of this system has not taken place, satellite imagery suggests that its engine has been repeatedly tested on the ground. Analysts conclude that the missile likely incorporates components of the Musudan and Taepodong-2 missile systems, and could have a range of 7,000 to 9,500 kilometers carrying a 500-700 ton warhead.<sup>36</sup>

Additionally, there is evidence to suggest the DPRK may be developing a multi-stage missile or SLV, the Unha-9, which would be considerably larger than the Taepodong-2. Although a complete Unha-9 rocket system has not been tested, a mockup of the booster was featured in the celebratory marches following the December 2012 Unha-3 launch. Additionally, North Korea's Sohae and Tonghae missile sites have both been upgraded to accommodate rockets significantly larger than the Unha-3.<sup>37</sup> The Unha 9 is expected to boast a longer range and larger payload

capacity than the Unha-3. Analysts have also noted that due to the booster's larger size, the Unha-9 would be significantly less mobile than the Unha-3, which raises the question whether attempting to transfer related technology to a strategic ballistic missile system would be worthwhile.<sup>38</sup>

On March 9, 2015, North Korea announced the successful "underwater test-fire of Korean-style powerful strategic submarine ballistic missile," publishing numerous pictures and video of the new KN-11 flying out of the ocean.<sup>39</sup> However, careful analysis of the images released by the Korean Central News Agency and related satellite imagery cast doubts on some of Pyongyang's claims. Despite North Korea's claim to have launched a solid-fueled system, the SLBM tested appeared to employ a liquid-fueled engine<sup>40</sup> and despite claims that it was launched from a submarine, the SLBM may have been launched from a submersible barge.<sup>41</sup> Additionally, the launch appeared to be only a test of the missile's ejection system and not a full test-flight.<sup>42</sup> However, analysts suggest the launch still represented a significant technical step forward and that a full flight test could take place in the near future.<sup>43</sup>

In addition to its development of strategic missiles, North Korea has in recent years put greater effort into modernizing its tactical and cruise missiles. One of the more conclusive advancements in this area has been the development of the KN-09 anti-ship cruise missile, which is believed to be based on the Russian Kh-35.<sup>44</sup> North Korea appeared to first test this system in 2014. In the following year, KCNA released images of the missile being launched from the decks of newly introduced catamaran surface-effect-ships.<sup>45</sup>

In 2014, three North Korean UAVs crashed in South Korea, which upon inspection resembled the SKY-09 UAV models produced by a Chinese company.<sup>46</sup> These drones did not pose an immediate threat to South Korean lives – they were only outfitted to take photographs – and were very small with an average wingspan of less than 10 feet.<sup>47</sup> However, some analysts have suggested that North Korea's UAVs could pose a security challenge because their small size could allow them to penetrate South Korea's air defenses, which are designed to counter more traditional threats.<sup>48</sup> North Korea has also displayed larger UAVs in military parades, and indicated that they are intended for attack operations as well as reconnaissance.<sup>49</sup>

Some analysts suggest that North Korea is now following a broader trend in which the militaries of weaker states in Asia pursue capabilities that enable them to blunt the force projection of more powerful states. The North's growing interest in fielding a variety of missile types, such as anti-ship missiles and extended-range KN-02 tactical missiles, has been interpreted as a manifestation of this trend, which stresses the strategic importance of anti-access operation and offers an affordable means to block or erode localized U.S.-ROK alliance force projection.<sup>50</sup> It has also been suggested that North Korea's military leaders may now be placing greater emphasis on tactical deployment of their nuclear and missile technologies as their perception of these systems' political and strategic utility has developed.<sup>51</sup>

## Profiles of Key North Korean Missiles

### **KN-02 & KN-02 ER** (*Tested, possibly deployed*)

The KN-02 is a tactical short-range ballistic missile (SRBM) with an estimated range of 100 to 120 km, which enables it to reach Seoul or military targets relatively close to the inter-Korean border.<sup>52</sup> The solid-fueled



KN-02 is a mobile, accurate, truck-mounted missile capable of carrying a variety of warheads, possibly including submunitions and chemical warheads. (Mounting a nuclear warhead on this missile is believed to be beyond North Korea's current capabilities.) The missile is believed to be the most accurate in North Korea's arsenal and has been frequently tested.<sup>53</sup> In 2015, North Korea conducted several extended-range KN-02, or KN-02 ER, rocket tests.<sup>54</sup> According to one source, these upgraded rockets have an estimated range of 170 km and about one hundred are believed to be in service.<sup>55</sup> The KN-02 ERs have been described by KCNA as "ultra-precision high-performance" rockets of "Korean style."<sup>56</sup>

### **KN-09** (*tested, possibly deployed*)

In early 2015, North Korea first announced a test of its new KN-09 anti-ship cruise missiles. Despite KCNA reports that the new missile system was an indigenous creation, analysis revealed that it closely resembled a Russian Kh-35 anti-ship cruise missile.<sup>57</sup> The original Russian model entered service in 1983 and had a maximum range of 130km with a 145 kg warhead and could travel at 300 m/s.<sup>58</sup> South Korea's Ministry of National Defense reported that the KN-09 test in February 2015 flew about 200 km, but that figure lacks an estimate on the size of the warhead used. Analysts suspect that North Korea could have modified



the original Kh-35 designs to improve it, as they have done with other missile systems. Although ships equipped with advanced Aegis missile defense systems may be able to successfully defend against this missile, it may pose a significant threat to older South Korean naval ships.<sup>59</sup>

### **Hwasong (Scud) Missiles** (*Tested, deployed, exported*)

The Hwasong -5 and -6, North Korean variants of Soviet Scud -B and -C ballistic missiles, are road-mobile, liquid-fueled SRBMs, and are believed to top the list of North Korea's missile exports.<sup>60</sup> Experts estimate that North Korea has deployed over 600 Hwasong missiles. The Hwasong-5 has an estimated range of about 300 km when carrying a payload of approximately 1,000 kg, while the Hwasong-6 can carry a smaller (700-750 kg) warhead to a range of 500-600 km – potentially putting the entire southern half of the Korean peninsula at risk.<sup>61</sup> The missiles are capable of carrying high explosives, submunitions, or



chemical warheads, although they are hampered by poor accuracy. It is possible, though unlikely, that North Korea could mount miniaturized nuclear warheads on its Hwasong missiles.<sup>62</sup>

**Nodong** (*Tested, deployed, exported*)

The Nodong is a single-stage liquid-fueled medium-range ballistic missile (MRBM) with a range of 1,000-1,600 km, which could make Japan a potential target.<sup>63</sup>



Because of the missile's poor accuracy, if armed with conventional warheads it would likely be used to target population centers rather than military targets.<sup>64</sup> The Nodong has been tested on several occasions and North Korea is estimated to have deployed approximately 200 of them.<sup>65</sup> Either the Nodong's components or the entire system has been exported and Iran's Shahab-3 and Pakistan's Ghauri-II missiles are believed to be based on its design.<sup>66</sup> Some analysts believe that North Korea's third nuclear test in February 2013 may have demonstrated its ability to miniaturize a nuclear weapon to fit atop a Nodong missile or that North Korea is nearing such a capability.<sup>67</sup> In addition, several Nodongs tested in November 2014 were reportedly fired at a higher launch angle, which would enable them to better evade missile defense systems in South Korea.<sup>68</sup>

**Musudan** (*Not tested, possibly deployed, possibly exported*)

The Musudan is a single-stage liquid-fueled intermediate-range ballistic missile (IRBM) with an estimated range of between 2,500 and 4,000 km, believed by some experts to be based on the Soviet SS-N-6 SLBM. Its range makes it potentially



capable of striking some U.S. military bases in the Pacific, although some analysts doubt that it could reach Guam from Korea.<sup>69</sup> While North Korea has not flight-tested the system, it may have conducted static tests of the missile's engine.<sup>70</sup> North Korea publicly displayed the Musudan during military parades in 2007 and 2010, and there have been several reports of the missiles being deployed, although these missiles may have been mock-ups.<sup>71</sup> In April 2013, two Musudan missiles were reportedly transferred to North Korea's east coast in apparent preparation for a test, but were subsequently removed from the test site without being launched.<sup>72</sup> There are also unconfirmed reports that allege North Korea sold Iran several Musudan missile kits and that Iran may have tested the Musudan for the North Koreans. Similarities between Iran's Safir missile and the Musudan have led some analysts to suggest both were derived from the Soviet SS-N-6, but a definitive link between the two systems remains difficult to determine in the open source realm.<sup>73</sup>

**KN-11** (a.k.a. Bukgeukseong-1, Polaris-1) (*partially tested, probably not deployed*)

North Korea first tested components of its submarine-launched ballistic missile, the KN-11, in June 2015. The dimensions of the KN-11 are similar to those of the R-27 or SS-N-6 sea-launched ballistic missiles developed by the Soviet Union in the 1960s. However, it is not certain whether the KN-11 is based on the R-27, because KN-11's precise dimensions are unknown and it lacks some of the visual characteristics that distinguish R-27s from other systems. If the KN-11 were fitted with a Nodong engine it would only have an estimated maximum range of 1600 km, while the original Russian R-27 had a maximum range of 2400 km when configured to deliver a 650 kg warhead. Before the KN-11 could become operational, North Korea would likely need to refine its ejection system, test its accuracy and reliability, and ensure the system is seaworthy.<sup>74</sup> It is unclear which submarine North Korea might use to deploy an SLBM system.



**Taepodong-1** (a.k.a. Paektusan-1) (*Tested, operational status unknown*)

The Taepodong-1 is a two-stage liquid-fueled MRBM that is estimated to have a range of 1,500-2,500 km.<sup>75</sup> The missile was modified to be a space launch vehicle (SLV) and tested in August 1998. During this test, the third stage failed to deploy its satellite payload, although the two initial stages of the launch vehicle are believed to have worked successfully. Some sources suggest that the DPRK has deployed 10 Taepodong-1 missiles.<sup>76</sup> However, other analysts believe that the Taepodong-1 is "a transitory product for the development of the Taepodong-2."<sup>77</sup> Such analysts think it is unlikely that the Taepodong-1 has been deployed at all, since it does not offer significant strategic advantages over the Nodong missile.<sup>78</sup>



**Taepodong-2** (a.k.a. Unha-2, Unha-3, Unha-9) (*Tested*)

The Taepodong-2 is a two- or three-stage liquid-fueled ballistic missile, first tested by North Korea in 2006, and (modified to be an Unha space launch vehicle) further tested in 2009 and twice in 2012. Although estimates of the Taepodong's range vary greatly and are difficult to confirm, it is widely believed to be an intercontinental ballistic missile (ICBM), potentially capable of striking the West Coast of the United States. While the most recent test of the Unha rocket largely succeeded in placing a satellite into orbit, several technical barriers may remain before the Taepodong-2 could be considered a fully-operational ICBM. In particular, North Korea would need to develop a re-entry vehicle capable of returning a warhead from the atmosphere back to Earth. Overcoming these challenges and increasing the operational reliability of the missile would require more flight tests. Additionally, the complex and time-consuming logistics of transporting this missile to a fixed launch site, erecting it, and fueling it



may diminish its military utility during a conflict.<sup>79</sup> The Unha-9 is a larger version of this system that has been put on display but not launched. This configuration is distinguishable due to a longer first stage and a slightly larger payload capacity.<sup>80</sup>

**KN-08** (*Not tested, operational status unknown*)

In June 2011, Secretary of Defense Robert Gates warned that North Korea was developing a road-mobile ICBM.<sup>81</sup> During a military parade in Pyongyang the following April, this new missile, the KN-08, was first publicly displayed. Some analysts dismissed the missiles as aspirational mock-ups; others concluded that they were part of a development process for a three-stage liquid-fueled mobile missile, possibly with intercontinental range.<sup>82</sup> The missile's origins are unknown and although its rocket motors have been tested, it has not been flight-tested.<sup>83</sup> Assessments of this system made by U.S. government officials have been mixed. USFK Commander General Scaparrotti testified in October 2014, "We've not seen it [the KN-08] tested at this point. And as you know, for something that that's complex, without it being tested, the probability of it being effective is pretty darn low."<sup>84</sup> However, U.S. commander of NORAD Adm. William Gortney said in April 2015, "Our assessment is they [North Korea] have the ability to put a nuclear weapon on a KN-08 and shoot it at the homeland and that's the way we think, that's our assessment of the process."<sup>85</sup>



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<sup>1</sup> Alexandre Mansourov, "Kim Jong Un's Nuclear Doctrine and Strategy: What Everyone Needs to Know", *NAPSNet Special Reports*, December 16, 2014, <http://nautilus.org/napsnet/napsnet-special-reports/kim-jong-uns-nuclear-doctrine-and-strategy-what-everyone-needs-to-know/>

<sup>2</sup> *Ibid.*

<sup>3</sup> See Markus Schiller, "Characterizing the North Korean Nuclear Missile Threat," Rand Corporation technical report (2012).

<sup>4</sup> "DPRK NDC Issues Statement Refuting UNSC Resolution," *KCNA*, January 24, 2013.

<sup>5</sup> See Joseph S. Bermudez Jr., "A History of Ballistic Missile Development in the DPRK," Center for Nonproliferation Studies, Occasional Paper #2 (1999), and "North Korea's Weapons Programs: A Net Assessment," International Institute for Strategic Studies (January 2004). For a review of alternative hypotheses, see Daniel Pinkston, "The North Korean Ballistic Missile Program," *Strategic Studies Institute* (February 2008), p. 15.

<sup>6</sup> "No-Dong 1," *missilethreat.com*, October 26, 2012, <http://missilethreat.com/missiles/no-dong-1/>

<sup>7</sup> Joseph Bermudez Jr., "DPRK-Pakistan Ghauri Missile Cooperation," *Federation of American Scientists*, May 21, 1998, <https://fas.org/news/pakistan/1998/05/ghauri2.htm>

<sup>8</sup> Bermudez, "A History of Ballistic Missile Development in the DPRK," *op. cit.*; Pinkston, "The North Korean Ballistic Missile Program," *op. cit.*, pp. 19-20.

<sup>9</sup> Charles P. Vick, "Taepodong 2 (TD-2), NKSL-X-2," *GlobalSecurity.org*, <http://www.globalsecurity.org/wmd/world/dprk/td-2.htm>

<sup>10</sup> Joshua Pollack, "Ballistic Trajectory: The Evolution of North Korea's Ballistic Missile Market," *Nonproliferation Review*, Vol. 18, No. 2 (July 2011).

<sup>11</sup> North Korea's increasing military cooperation and missile sales to Myanmar in the late 2000s may have been an exception to this trend. See Joshua Pollack, "North Korea's Shrinking Role in the Global Missile Market," *38 North*, July 29, 2011.

<sup>12</sup> Tom Gjelten, "What North Korea's Rocket Launch Tells Us About Iran's Role," *NPR*, December 14, 2012, <http://www.npr.org/2012/12/14/167212153/what-north-koreas-rocket-launch-tells-us-about-irans-role>

<sup>13</sup> Leon V. Sigal, "The United States and North Korea: Cooperative Security on the Agreed Framework and Beyond," in Richard N. Haass and Meghan L. O'Sullivan, *Honey and Vinegar: Incentives, Sanctions, and Foreign Policy* (Brookings Institution, 2000), p. 87; Jon Brook Wolfsthal, "The Israeli Initiative," *Bulletin of the Atomic Scientists*, Vol. 49, No. 7 (September 1993), pp. 8-9.

<sup>14</sup> Gary Samore, "U.S.-DPRK Missile Negotiations," *The Nonproliferation Review* (Summer 2002), p. 17; "U.S. North Korean Missile Talks Collapse Following Defection," *Arms Control Today* (August 1997).

<sup>15</sup> The negotiations were conducted as part of the "Perry Process," a year-long review of U.S. policy options toward North Korea.

<sup>16</sup> Samore, "U.S.-DPRK Missile Negotiations," *op. cit.*, p.17-18.

<sup>17</sup> Donald G. Gross, "U.S.-Korea Relations: Slow Start in U.S. Policy toward the DPRK," *Comparative Connections* 1st Quarter 2001, Vol. 3, No. 1 (April 2001), [http://csis.org/files/media/isis/pubs/0101qus\\_korea.pdf](http://csis.org/files/media/isis/pubs/0101qus_korea.pdf).

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