

# North Korea's Missile Program: From a Physicist's Notebook

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In brief, North Korea during the early 1980s was able to obtain a 300-kilometer range Soviet Scud missile, which it copied and began to build domestically. It sold a large number of these missiles to Iran, which used them in its war with Iraq. In the late 1980s, North Korea developed and built a longer-range version of the Scud that could reach 500 kilometers.

In parallel with that program, North Korea began to develop a larger missile -- the Nodong -- that is believed to have a range of 1,000 to 1,300 kilometers. The missile body is larger in diameter than the Scud, which could make it easier for the missile to accommodate an early generation nuclear warhead. (North Korea is believed to have enough plutonium for perhaps two nuclear weapons, but it is not known whether it has developed a working weapon.)

## **North Flight-tests Nodong**

North Korea flight tested the Nodong missile only once (in 1993), but the Pakistani Ghauri missile, which has been flight tested at least twice, is widely believed to be a Nodong missile or closely related to it. Intelligence reports say North Korea has begun building and deploying Nodong missiles on mobile launchers.

The Nodong range is significant since it would allow North Korea to target all of Japan, and if sold abroad would allow Iran and Libya to target Israel. Press reports have claimed that Nodong development was partially funded by Iran, and that North Korea has provided technical assistance to Iran's missile program. Press reports also state that North Korea recently sold Nodong missiles to Libya. Foreign sales provide both an incentive to continue the missile program and money to allow North Korea to do so.

In August 1998, North Korea launched its first multiplestage missile, the Taepo Dong 1. The launch is believed to have been an unsuccessful attempt to launch a small satellite, and was highly controversial since the missile flew over Japan. The missile appears to have consisted of a Nodong missile as the first stage, and a missile similar to a Scud as the second stage. In addition, the missile carried a small solid-fuel third stage — a discovery that surprised the U.S. intelligence community.

This launch was important for several reasons. First, if used as a ballistic missile, this missile could deliver a small payload over a long distance. For example, it might be able to carry a 300-kilogram payload 6,000-6,500 kilometers. Such a missile could reach parts of Alaska with a small biological warhead, and therefore is seen by some as proof of a long-range missile threat to U.S. territory. Second, the launch demonstrated North Korea's ability to do multi-staging, crucial for developing long-range missiles. This launch showed North Korea has developed a key technology needed to build even longer-range missiles.

On the other hand, the capabilities of such a missile must be kept in perspective. It would be highly inaccurate, with an expected inaccuracy possibly of tens of kilometers. Without a significant flight testing program, its reliability would be unknown, but would likely be low. Moreover, with a payload of 800-1,000 kilograms, which might be required for a nuclear warhead, the range would be less than 3,000 kilometers.

North Korea is also believed to be developing an even longer-range missile, the Taepo Dong II. The first stage would be a new, large booster powered by four Nodong engines. The second stage is believed to use a single Nodong engine. To reach intercontinental ranges with a significant payload, the missile would likely have a third

stage, although its characteristics are not known. Such a missile could probably carry a significant payload (large enough to accommodate a nuclear weapon) to the western parts of the lower 48 U.S. states. If the North was able to make the body out of light-weight material such as aluminum alloys rather than steel, it could increase the range.

A key question is how soon a Taepo Dong missile might be tested. Such a missile would be considerably larger than North Korea's current missiles and would pose a number of technical problems. The added complexity of this missile would raise additional questions about its reliability, especially if the flight testing program is limited, as is assumed. Moreover, North Korea's motivation to build this missile may have decreased since the spring of 1999, following U.S. Special Envoy William Perry's visit to Pyongyang. After that meeting, North Korea pledged not to flight test new missiles while discussions with the United States on missile issues continue. Reportedly there is evidence it has stopped some ground development and testing activities, part of the Taepo Dong II development program.

On the other hand, North Korea has shown considerable capability in developing missiles. Unlike Iraq, which built its al Hussain missiles using parts taken from Soviet Scud missiles, North Korea was apparently able to build working engines and guidance systems for the Scud missiles it produced.

### **North Capable of Developing ICBM**

Moreover, the design of the first two stages of the TD-2 appears to be roughly similar to the Chinese intermediate-range DF-4 missile, which was given a third stage to produce the DF-5 ICBM. This does not imply Chinese help in its design, but that the design could be used successfully to build an ICBM if North Korea decided to do so. Finally, there are continuing reports of Russian technical assistance to the North. If true, this could be a significant help to North Korea's program.

In sum, North Korea's demonstrated ability to engineer missiles suggests that it is possible it could develop a long-range missile like the Taepo Dong II missile in the next five years if it decided to do so, especially if it is getting foreign technical assistance. It has defended such development as supporting a domestic satellite-launch program, although such launch vehicles could also be used as ballistic missiles. Given its recent engagement with South Korea and the United States, however, it is not clear that it will decide to invest in such development. And, as with the Taepo Dong I missile, if it did build the Taepo Dong II, questions about its reliability and accuracy would limit its military utility, although it would allow North Korea to threaten a terror attack.

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