STICKS "TRUMP" CARROTS FOR NORTH KOREA

BY GERALD E. MARSH

"If the U.S. could make it clear to China that the consequence of inaction [concerning the curbing of North Korea] would be a nuclear-armed Japan, that might be an adequate incentive."

NORTH KOREA'S fixation on nuclear weapons began just after World War II. By 1947, Korea no longer was occupied by the Japanese—and Chinese influence had waned. In 1948, South Korea officially was recognized by the General Assembly of the United Nations, and both it and North Korea were given full membership in the General Assembly in 1991. In 1950, North Korea, under Kim Il-sung, with the acquiescence of the Soviet Union, invaded South Korea. This was shortly after China's Chiang Kai-shek, a U.S. ally, was forced by Mao Tse-tung to flee to Taiwan with 1,000,000 or so followers, much to the detriment of the Taiwanese. South Korea had as its ally the U.S., while North Korea had both the Chinese and the Soviets.

In January 1953, Pres. Dwight D. Eisenhower came into office. At that time, there already had been two years of nonproductive peace talks, during which the Korean front line corresponded to what is known as the DMZ or demilitarized zone. Eisenhower threatened to use nuclear weapons in North Korea and China, if necessary, to end the Korean War. The armistice was achieved shortly thereafter on July 27, 1953.

North Korea views this act by Pres. Eisenhower as a form of nuclear blackmail. As put by Foreign Minister Pak Song-chol in August 1962 when speaking with Soviet Ambassador Vasily Moskovsky in Pyongyang: "The Americans . . . blackmail the people with their nuclear weapons and, with their help, rule on these continents and do not intend to leave. Their possession of nuclear weapons and, the lack thereof in our hands, objectively helps them, therefore, to eternalize their rule. They have a large stockpile and we are to be forbidden even to think about the manufacture of nuclear weapons."

Today, the world is faced with the results of this history. The greatest threat is a nuclear standoff among North Korea, South Korea, China, Japan, and the U.S.. a standoff whose stability will be far more unreliable than our Cold War experience with nuclear deterrence. Should North Ko-

Korean Central News Agency

North Korea's Kim Jong-Un has the entire world on alert.

rea succeed in developing light enough nuclear weapons that could be carried on Intercontinental Ballistic Missiles (ICBMs) or Intermediate Range Ballistic Missiles (IRBMs), South Korea and Japan will develop and deploy missile defenses. Once North Korea shows, through complete testing of their entire ICBM or IRBM weapon systems—including mock warheads and their associated reentry vehicles—that it has achieved this capability, any missile launch, including test launches, could lead to activation of these defenses.

Since such defenses thus far have proven to have only limited effectiveness, the Japanese would be forced, despite their history, to develop nuclear weapons of their own since, in the current political climate, they would not be likely to rely on the U.S. "umbrella" guaranteeing their security as part of our strategy of extended nuclear deterrence.

To optimize the probability of success, defenses would have to be located in regions where they would be able to intercept the missile just after it lifted off from the ground (during the boost phase), and this defense would have to be kept on a hair trigger—meaning that launch authority would have to be delegated. The U.S. could not afford to wait until it had confirmation that it was being targeted, since terminal-phase defenses are far more unreliable than boost phase—and detonation of a nuclear weapon on any part of U.S. soil due to a defense failure absolutely would be unacceptable.

Boost-phase defenses themselves are destabilizing not only because of the necessity of predelegating launch authority, but because they must be placed near enough to North Korea to be effective. The defenses would have to be deployed on ships or submarines; South Korea would not be a possible location because any launch from there likely would be interpreted by North Korea as an attack, triggering retaliation with conventional weapons across the DMZ.

A nuclear weapon that only can be delivered by bombers may be a serious concern for South Korea, and certainly make Japan apprehensive, but the effectiveness of today's antiaircraft defenses minimizes the importance of such a threat to countries other than South Korea. The only advantage of bombers for North Korea is that they would not need to develop very sophisticated weapons, and such relatively low-cost weapons also could be delivered by sea into littoral regions and harbors.

Given the North Koreans' concentration on developing solid-fueled rockets, it is more likely that they understand the much greater utility of a minimal deterrent comprised of ICBMs that rapidly could be launched loaded with more-sophisticated nuclear warheads, but this is not likely to be achievable in the immediate future, nor would it constitute an existential threat to any of the larger nuclear states.

It took the U.S. many tests to develop reliable solid-fueled ICBMs and their requisite warhead reentry vehicle technology. Dependable nuclear warheads intended for ICBMs comparable to those of the advanced powers are far beyond what the North Koreans could hope to design and manufacture in the next decade without a massive nuclear-testing program.

Still, a real threat remains. "Behind the Trump Administration's sudden urgency in dealing with the North Korean nuclear crisis lies a stark calculus: a growing body of expert studies and classified intelligence reports that conclude the country is capable of producing a nuclear bomb every six or seven weeks," according to an April 25 *New York Times* article by David Sanger and William Broad, adding that, as of 2010, North Koreans "appear to have a complete uranium enrichment facility."

Others claim North Korea also is close to making hydrogen bombs and boosted-fission weapons. This claim is almost certainly nonsense. Boosted-fission weapons are tricky to design and would require a sophisticated modeling capability and a significant number of nuclear tests.

Nuclear weapons use either uranium or plutonium. When extracted from rocks, uranium is unsuitable for weapons use and must be "enriched." Natural uranium is composed of two different isotopes and, it is the lighter one—comprising only 0.7% of the natural metal—that must be separated for weapons use. This is what the centrifuges one hears so much about are used for, but simple uranium weapons are heavy and not suitable for ICBMs, whose range depends on the weight of the warhead. It is plutonium, which must be produced in nuclear reactors from uranium, that is of interest to an ICBM program.

The plutonium factor

There are two types of plutonium of importance that are produced in nuclear reactors: weapons grade and reactor grade. Weapons grade has a low amount of the heavier isotopes of plutonium, the concentration of which increases the longer the uranium used to produce the plutonium remains in the nuclear reactor. To produce good-quality weapons-grade plutonium—with a concentration of the most-important heavy isotope (Pu240)—a short "burnup" fuel cycle is employed, meaning that the reactor fuel rods are removed earlier than they would be if the reactor was utilized to produce electricity.

The problem with Pu240 is that it spontaneously emits neutrons that can cause a nuclear weapon to predetonate. Nuclear weapons use high explosives to compress the plutonium to achieve a critical mass. If a neutron sets off the chain reaction in the plutonium before it maximally is compressed, this is called predetonation. This greatly can reduce the yield (size) of the nuclear explosion.

What we need to know is how much weapons-grade plutonium the North Koreans could have produced—and how much they can produce at present. This, in turn, depends on the number of operational nuclear reactors they have. As of 2015, so far as we know, they have only one small reactor estimated to have a power of 25 megawatts-thermal (MWt) at the Yongbyon Nuclear Research Center north of Pyongyang. However, the history of this reactor is somewhat murky. Moreover, the configuration used in modern weapons probably is beyond North Korea's capability for many years.

It is possible, however, that extensive high-explosive testing could reduce the weight of the designs available to them within perhaps a decade or less. Unless the North Koreans complete work on a larger 100 MWt reactor, which was not the case as of 2015, they would be limited to producing a maximum of enough weapons-grade plutonium for one bomb per year using these early designs.

Should North Korea be able to reduce the amount of high explosive needed for the weapon so as to reduce its diameter to, say, about half a meter, the weight could be as low as 80 kg, which could be adequate for their current ICBM design. If the 2016 photo showing Kim Jong-un with his nuclear warhead mock-up perhaps a meter in diameter is anything more than a publicity stunt, there is not much time left.

North Korea has carried out a handful of nuclear tests as of this writing, but it will have to go through an extensive testing program before it can deploy reliable nuclear-armed ICBMs or IRBMs. The final phase of development would have to include launching the missile and its reentry vehicle with a properly configured weapon, along with its fusing, but with a substitute for the fissionable material. The U.S. and Great Britain routinely carry out such tests even today. They are called demonstration and shakedown operations known as DESO tests. Should North Korea get to this point, the political situation can be expected to deteriorate rapidly.

The only diplomatic avenue that appears to be open for the U.S. is to put great pressure on China to do what they can to stop the North Korean programs, but the chances are not great that China could succeed without the regime collapsing, thus China may be reluctant to take on the responsibility. Should the North Korean government collapse, China could be faced with a unified Korea allied to the U.S. or vast numbers of refugees—or both.

Japan, meanwhile, has a very advanced nuclear energy sector and it could produce nuclear weapons in a very short time. If the U.S. could make it clear to China that the consequence of inaction would be a nuclear-armed Japan, that might be an adequate incentive. ★

***Gerald E. Marsh**, a retired physicist with the Argonne National Laboratory, Lemont, Ill., and fellow of the American Physical Society, College Park, Md., was a consultant to the Department of Defense on strategic nuclear technology in the Reagan, H.W. Bush, and Clinton administrations, and served with the U.S. START delegation in Geneva, Switzerland.*