SHORENSTEIN APARC STANFORD

October 9, 2006

Technical Perspective on North Korea's Nuclear Test: A Conversation between Dr. Siegfried Hecker and Dr. Gi-Wook Shin

The international community appears to have been stunned by North Korea's test of a nuclear device. While the media has predominantly focused on the political implications of the test, it is also important to understand exactly what occurred from a technical perspective. On Monday, October 9th, Dr. Gi-Wook Shin, Director of the Korean Studies Program and the Shorenstein Asia-Pacific Research Center at Stanford University, asked Dr. Siegfried Hecker, Emeritus Director of the Los Alamos National Laboratory and visiting professor at the Center for International Security and Cooperation at Stanford University about the nature of the test executed by North Korea and possible technical implications.

GWS: Dr. Hecker, could you please briefly explain the technical dimensions of what has happened? North Korea is claiming great success, but there are some questions about whether this presumed nuclear test was really successful or meaningful.

SH: At this point, as I understand it, the North Koreans have conducted what they call a nuclear test.

South Korea has said seismic signals appear to indicate a 0.5 kiloton, or sub-kiloton, explosion. From reports I have seen, the Australians and the French believe the blast was about 1 kiloton. Thus, three countries have given assessments on the power of the underground explosion, ranging between 0.5 kilotons and 1 kiloton, or 500 and 1000 tons. This likely indicates a nuclear explosion of a relatively low yield, compared to what one would typically expect. Although the Russian defense minister has apparently commented that the explosion was between 5 and 15 kilotons, I have not heard any other nation estimate in this range.

By comparison, the Nagasaki bomb was approximately 20 kilotons, and the initial tests of the five major nuclear powers were all quite large, on this order. Also, when both India and Pakistan tested multiple devices in 1998, some of these tests were of a substantial yield, at least 20 kilotons. But each country also tested three devices that were said to result in explosions of less than a kiloton. Whether these devices did not work or were experimental in nature is still unknown. So, a test on the order of that conducted by North Korea is not unheard of, but it is apparent that the North Korean device produced an explosion considerably smaller than most countries' first nuclear tests.

Regarding the technical dimensions of this event, I would offer two provisos: first, we must give scientists more time to analyze the seismic signals, and second, we must allow more time for analysis of how those seismic signals translate to the yield of the device. This latter task involves a thorough understanding of relevant geology—scientists make models to predict this, but there is always some uncertainty.

GWS: Given the relatively low yield of the test, is it possible that what North Korea has "tested" is not a nuclear device but very powerful conventional weaponry?

SH: It is most likely that this was indeed a nuclear device. There are two plausible explanations for why this test resulted in a relatively low yield. One possibility is that the North Koreans attempted to test a relatively simple nuclear device that was meant to be large, but it did not work quite right. There are two reasons the test of such a device might not have gone as planned. First, the detonators might not have exploded at exactly the right time or the explosive might not have been of the right quality, thus producing a lower yield. Second, if the timing of the "initiator" (additional neutrons that are introduced) was not quite right, this could also decrease the expected yield of the device.

Another possibility is that North Korea was actually trying to test a smaller, much more sophisticated nuclear device, one with a lot of instrumentation to monitor implosion. North Korea could have learned a great deal from such a test, but I would be surprised if the country had really designed the device to be that small.

GWS: This test marks the failure of the disparate policy approaches of South Korea and the United States—neither nation was successful in arresting DPRK nuclear development. But just how advanced North Korea's nuclear program is remains unclear. In the Korean media, there has been debate over whether North Korea's nuclear test was a success or a failure. What do you think?

SH: I would not say that the test failed. It is simply too early to judge, and we do not know exactly what North Korea had hoped to achieve. If North Korea wanted to use this test as a demonstration, then perhaps it was not very successful. It may be the case that the test did not work as well as anticipated if the device in question was a simple nuclear device. If North Korea was testing an advanced designed that was very well instrumented and monitored, it may have learned a great deal from this test.

It is important to wait to see an accurate yield for this test and then to look at the range of possibilities for why it might have been executed. From a scientific perspective, it is important not to overreact and not to go beyond what is actually known.

GWS: You said previously that when India and Pakistan tested nuclear devices in 1998, they both set off multiple explosions. Is it correct that North Korea has set off a single explosion?

SH: From what we have learned so far, it appears that North Korea has tested one device. This is what the North Koreans announced they would do. Scientists will have to carefully analyze the seismic signals to be sure, however, as for example, when India tested, it set off two devices simultaneously. We have not yet seen all the seismic evidence.

GWS: If North Korea were to use such a "low yield" device as a weapon in a major metropolis like Seoul, what kind of impact would it have?

SH: A 1 kiloton bomb in a major metropolis, though a relatively low-yield nuclear device, would still be devastating and catastrophic. Many thousands would experience instant death, and due to radioactivity, there would also be many delayed deaths. A device of this size would not wipe out the entire city, as was largely the case in Hiroshima and Nagasaki, but it would cause major, significant damage.

GWS: Based on the scale of the explosion, was this device something that even terrorists could assemble?

SH: One kiloton in terrorist hands would indeed be catastrophic. I am very concerned that North Korea's nuclear material might fall into terrorist hands.

GWS: The possible marriage of this demonstrated nuclear capability and North Korean missiles is extremely dangerous. With reference to the North's nuclear and missile capabilities, is testing useful for making smaller nuclear devices—devices small enough to be placed on a missile?

SH: If North Korea is intent on making a nuclear warhead, this test could be a step in that direction. Making smaller nuclear devices by nature means making more complex nuclear devices. For much of the Cold War, this was a major goal for both the Soviets and the Americans. For North Korea, at this point we cannot say that the test was successful in terms of this aim of miniaturization, though again, North Korean scientists may have learned a lot in this regard. It is extremely difficult to say how soon North Korea could achieve miniaturization with the limited information we have about this test.

Miniaturization is a very big step, and it cannot be accomplished without nuclear testing. This could have been one of the most important reasons that North Korea undertook this test. It must be noted that their missiles are the other part of this equation, and there is not great confidence in the reliability of these missiles, especially those that performed poorly during the July test.

GWS: North Korea has certainly made a political statement with its nuclear test, but from a technical perspective, do you expect additional testing? What is your assessment of North Korea's technical capabilities, in light of your recent visits to the nation?

SH: At this point, North Korea could want another test for two technical reasons. First, if this was a simple device, they will want to fix the problem and demonstrate an explosion of a higher yield. If this was a more advanced design, they may have learned a lot but would still desire another test in order to gain an appropriate level of confidence in the device.

In January 2004, I visited the Yongbyon nuclear reactor and in August 2005, I visited Pyongyang. On the basis of those visits, I would estimate that North Korea has enough plutonium for 6 to 8 nuclear devices, though there is some degree of uncertainty in that estimate. Overall, I estimate the North has 40-50 kilograms of weapons-grade plutonium, and generally 6-8 kilograms are required for each weapon. I also estimate that North Korea could gain one additional weapon per year, given the current rate of reprocessing.

In terms of skilled people and facilities, North Korea has very good capabilities, up to the point of and including reprocessing plutonium. However, to go from reprocessing plutonium to building the device itself takes a whole new set of engineering and physics skills.

GWS: Given North Korea's limited amount of weapons-grade material, its government would presumably want to conserve as much as possible, right?

SH: Yes, and this is probably one of the reasons North Korea did not set off multiple explosions like India and Pakistan did. North Korea has very limited material, and therefore it will want to be judicious. With this conservation imperative, North Korea will want to fully assess what has been learned from this first test before it attempts a second test.

GWS: From a technical perspective, is it difficult to say how long it may be until North Korea conducts a second test?

SH: Yes, it is very difficult to say, because it depends on factors related to this test about which we are still uncertain. If North Korea was satisfied with this test and all preparations have already been made, a second test could take place within a few days. Yet if the findings from this test surprised North Korea, the device may have to be rebuilt, and that could take weeks or months. One thing we know for sure is that they do not have a lot of weapons-grade material, and they will have to carefully judge how to use it.

GWS: You have said that a major danger from the North Korean nuclear program is the possibility of plutonium transfer. How serious is this possibility? Are you also concerned about transfer of nuclear technology?

SH: Well, a test does mean that there is now less material that could possibly be transferred.

I feel strongly that the principal danger from the North Korean program is the plutonium itself, and the possibility it would find its way to a third party, perhaps into terrorist hands or into the hands of other nations. The reason I believe this is the biggest danger is that North Korea could be restrained by its neighbors from ever actually using a nuclear device, but a third party, especially a non-state actor, may not be "restrainable."

The nuclear test will not have an impact on how marketable the plutonium is. Yet, for the export of nuclear technical know-how, a successful test could make a big difference in the appeal of North Korean technology, especially to a nation like Iran.

GWS: The current nuclear crisis erupted in October 2002, when U.S. officials confronted North Korea about its possession of a uranium enrichment, or HEU, program. North Korea has thus far denied having such a program. I understand this type of program is much more difficult to detect. Would a uranium-based device require testing?

SH: North Korea has stated that it does not have an HEU program. My own opinion is they have some type of enrichment program, owing to Pakistani President Musharraf's statements that his nation provided Pyongyang with some of the required technology and equipment. We simply do not know how far North Korea has progressed in this program.

The HEU program is very difficult to detect—there are fewer signatures than for a nuclear reactor and this type of program is easier to conceal, given the smaller size of the facilities required. However, if we assume statements made by A.Q. Khan and President Musharraf are accurate, it may be some time before North Korea can produce significant quantities of HEU.

Once North Korea has accomplished this, a uranium bomb will be easier to make, and North Korean scientists will have more confidence in this type of device without testing.

GWS: All indications are that North Korea will be further isolated after this test. Will this increased isolation impact the country's continued nuclear development?

SH: At this point, from what I saw at Yongbyon, current North Korean operations do not depend on external help or supplies. Thus, isolation makes little difference in this regard. For the uranium program, technical isolation would probably cause a slowdown, because North Korea would benefit from additional technical purchases from the outside world. But the uranium program does not appear to be a centerpiece of North Korea's nuclear efforts.

GWS: After this nuclear test, is the situation more dangerous?

SH: I believe the major threat came around 2003 when North Korea reprocessed a major amount of plutonium, thus crossing the threshold to become a major threat. I have always taken the North Korean threat very seriously, and I believe all the governments and peoples involved should take it very seriously as well. First and foremost, the imperative should be to make sure that nuclear materials stay in North Korea and are not transferred to third parties.

Transcript prepared by Kristin Burke, Research Associate at the Walter H. Shorenstein Asia-Pacific Research Center

For more information about the Walter H. Shorenstein Asia-Pacific Research Center please visit our website at http://APARC.stanford.edu.

Copyright 2006 Shorenstein Asia-Pacific Research Center