Closing Keynote Address
Global Nuclear Risk Reduction by Science Diplomacy

Siegfried S. Hecker, Ph.D.

When I gave this presentation in October 2010, the world faced a troubling reality for advocates of nuclear nonproliferation. The 20 months between then and now have seen the situation deteriorate significantly. North Korea is likely supplementing its small nuclear arsenal by developing a second path to the bomb through uranium enrichment, and Kim Jong-il's death may make substantive negotiations more difficult, at least in the short term. An increasingly isolated and aggressive Iran has moved steadily toward the nuclear weapon option, having made significant advances in its uranium enrichment program during this time. I, along with former Secretary of Defense William J. Perry, continue to work to mitigate global nuclear threats through the Nuclear Risk Reduction Project. The goals of this project are simple: to reduce the threats of nuclear weapons by working towards: a) fewer nuclear weapons in the world; b) fewer fingers on the nuclear trigger; and c) keeping nuclear weapons and material out of terrorists' hands. While the goals are simple, achieving these goals is the challenge not only for our lifetimes, but also that of the next generation. I have devoted much of my career and the last two decades to decreasing nuclear risks through scientific diplomacy in places like North Korea, Russia and China. In this presentation, I review my efforts to reduce nuclear risks and emphasize the essential role that scientists must play in working to mitigate the risks of nuclear weapons and the spread of weapon-usable nuclear material.

Fewer Nuclear Weapons

Dr. Perry, along with former Secretaries of State George Schultz and Henry Kissinger and former Senator Sam Nunn, has dedicated much of the past five years toward a world free of nuclear weapons. The four horsemen, as they have been affectionately called, advocate a set of steps that reduce the number of nuclear weapons that include ratification and entry into force of the Comprehensive Nuclear Test Ban Treaty (CTBT), negotiation and ratification of a Fissile Material Cut-Off Treaty (FMCT), further disarmament negotiations, and reductions in tensions surrounding ballistic missile defense. These steps constitute an important part of a broader nonproliferation agenda that should be adopted worldwide to reduce nuclear risks. I am currently engaged with my Stanford and Los Alamos National Laboratory colleagues in a study analyzing the benefits and costs of ratifying the CTBT and expect to hold a workshop presenting the findings in Washington D.C. in the spring of 2012. Entry into force of the CTBT could play a vital role in limiting the ability of states that possess nuclear weapons from increasing the sophistication of their nuclear forces and may help erect additional barriers for aspiring nuclear states to test weapons and declare themselves as nuclear weapons states.

Fewer Fingers on the Nuclear Trigger

In the last ten years, North Korea built and tested nuclear devices and declared itself to be a nuclear power. Iran has inched closer to a nuclear weapon capability, but apparently has not yet decided to proceed with building nuclear weapons. Decreasing the number of countries that possess nuclear weapons is essential to any effort to increase peace and stability around the world. I have visited North Korea seven times,[1] six with my Stanford colleague John Lewis, with the goal of making an assessment of North Korea's nuclear capabilities. Such assessments improve our understanding of the risks of their program and assist policy makers in laying the way for formal, productive negotiations. In my first visit in 2004, I held in my hands a sealed glass jar containing what North Korean scientists told me was 200 grams of plutonium metal, the essential ingredient for a bomb. After asking a number of basic questions of North Korea's scientists and conducting some experiments once back at Los Alamos to simulate some of the situations experienced in the Yongbyon nuclear complex, I concluded with high confidence that North Korea had mastered what we did in the Manhattan Project and that it could make a rudimentary plutonium bomb – which it confirmed in October 2006 when it detonated its first nuclear device. Although that test was only partially successful, it confirmed its ability to build a working plutonium bomb with a second, successful test in May 2009. The extraordinary access the North Koreans gave me to their nuclear facilities allowed me to conclude that today, North Korea likely has 24-42 kg of plutonium, sufficient for 4 to 8 bombs. Based on their test history, I believe these are likely primitive plutonium bombs on the order of the Nagasaki plutonium bomb. I do not believe that they have been able to miniaturize their nuclear devices to mount on ballistic missiles.

In each of my visits since, North Korea has had a specific message for me and my American colleagues. In 2004, for example, they allowed me to hold the plutonium in order for me to carry the message back to Washington that Pyongyang now has the bomb. In 2010 (only one month after I gave this presentation), they showed me and my Stanford colleagues an impressive uranium enrichment facility and demonstrated their determination to build an indigenous light water reactor – and, to the consternation of the rest of the world, provide Pyongyang with an alternative route to the bomb. These visits were interspersed between formal and informal negotiations by the U.S. government. Upon my return from each visit, I briefed U.S. government officials on what I saw and what the North Koreans told me. I believe that our visits have helped provide important information, both technical and diplomatic, for official negotiations to be successful. From these visits, we know that at present, North Korea likely possesses 4 to 8 primitive plutonium bombs, is constructing a 25 megawatt-electric Light Water Reactor (LWR) and is pursuing a robust uranium centrifuge enrichment program. I believe it is unlikely that the North will give up its nuclear weapons anytime soon, especially after the death of Kim Jong-il and the transfer of power to his young son. Nevertheless, I strongly believe that negotiations should restart to limit further escalation of their nuclear program and prevent future nuclear tests. I advocate a strategy of three no's in exchange for one yes: no more bombs, no better bombs and no nuclear exports, in exchange for addressing Pyongyang's security concerns that lie at the heart of this dispute.

North Korea is not the only international nonproliferation concern. Iran is putting in place all the capabilities necessary so that it can flip a switch if it chooses and develop nuclear weapons in less than a year. It is increasing capacity to enrich uranium in its facilities in Natanz and Qom. Tehran claims that these facilities are being operated to supply low-enriched uranium for its commercial and research reactors. However, Tehran has not provided sufficient transparency in its nuclear program to assure the rest of the world that it will not use these or other covert facilities to produce highly-enriched uranium bomb fuel. Iran is also constructing a heavy-water reactor in Arak that it claims to use for medical isotope production, but it will produce plutonium suitable for weapons as a side product. It has also engaged in experiments relating to weaponization and nuclear triggers. These developments indicate Iran's desire to possess a nuclear option, even if it has not yet made the decision to build the bomb. Pakistan is further developing its nuclear arsenal and employing troubling nuclear strategies as far as deployment and targeting. These developments increase the risk of a nuclear exchange with India over disputes along the Kashmir border, or over attacks by proxy terrorist groups supported or at least tolerated by elements of Pakistani government. Solving these problems is far from simple or easy. As is the case for North Korea, our project works alongside governmental efforts to catalyze a path for official negotiations or collaborations to reduce these nuclear risks.

Keeping Nuclear Bombs and Material Out of Terrorists' Hands

One of my greatest concerns is that a terrorist organization might gain access to a nuclear weapon or nuclear material and explode it somewhere in the world. The risks of nuclear terrorism present very different challenges from the state-centric risks described previously, given the difficulties in deterring or denying terrorists. I see three main risks associated with terrorists and nuclear technology. First, a terrorist group could detonate a nuclear device, resulting in a massive and devastating loss of life and property. Second, a terrorist group could get its hands on radioactive materials and detonate a radiological dispersal device (RDD), otherwise known as a "dirty bomb." Third, a terrorist group could sabotage a nuclear facility or power plant with the goal of releasing radiation into a populated area. Of these three risks, that of a "dirty bomb" is the most likely given that radiation sources are everywhere – as key ingredients of medicine, commerce and agriculture.

Dirty bombs are weapons of mass *disruption* rather than weapons of mass destruction, likely causing more psychological damage and economic damage than a massive loss of life. The most important measure to deal with a dirty bomb is be prepared to respond since prevention is very difficult given the ubiquitous nature of the radiation sources that can be used to make a radiation dispersal device and the simplicity of constructing it. It is critical, therefore, to work with first responders, the media and the public to respond effectively in the event of a terrorist attack.

Although nuclear weapons are much less likely to be used by terrorists, the effects would be devastating. The most likely route for a nuclear weapon to get into the hands of terrorists is that they may gain access to fissile materials, plutonium or highly-enriched uranium, by theft or diversion from a state's nuclear facilities (fortunately, the production of fissile materials is beyond the means of all terrorist organizations today). With the bomb fuel in hand, terrorists may then build a simple, improvised nuclear device and find a way to detonate it in a metropolitan area somewhere in the world. The most important measure to prevent this type of nuclear terrorism is to secure the fissile materials at their source – that is, to make certain they do not get out of control of the governments that possess them. This effort has consumed much of my nuclear scientific cooperative activities around the world during the past two decades.

I have visited Russia 43 times since 1992 both while I was at the Los Alamos National Laboratory and as an academic with the goal of helping the Russian nuclear and security specialists to secure their enormous stock of fissile materials – a legacy of the huge Soviet nuclear programs. The Soviet-style security through guns and guards no longer sufficed after the dissolution of the Soviet Union at the end of 1991. We have worked closely with the Russians to help them develop a comprehensive system of nuclear safeguards that we call materials protection, control and accounting (MPC&A). President Obama focused the world's attention on the risks of nuclear security and terrorism in his April 2010 Nuclear Security Summit. The summit's goal of locking down the world's nuclear materials in four years, while admirable and important, is insufficient in dealing with the risks of the spread of nuclear materials. Nuclear materials are constantly moving between nuclear plants and facilities and military installations – it is not possible to simply lock them down in a vault and declare the job completed. More important is the adoption of a system of MPC&A for comprehensive safeguards.

A Role for Scientific Diplomacy

Although the end of the Cold War has greatly reduced the likelihood of a massive nuclear war, the likelihood of a nuclear explosion somewhere in the world has actually increased. Of greatest concern are a potential nuclear exchange between Pakistan and India, the nuclear ambitions of North Korea and Iran, and the threat of nuclear terrorism. Twenty years after I first started lab-to-lab contacts, I believe more firmly than ever that scientists can play an important role in international security diplomacy. They look through different lenses than politicians and build different relationships. They typically develop deep personal friendships. They speak a common language and usually respect each other, making it easier to build trust. Communications are much less formal, with e-mail instead of diplomatic cables, and scientists can explore a broader spectrum of potential solutions than government officials. To conduct science diplomacy effectively, I found it was crucial to work constructively with the government. But it is also important to share our findings with the public at large. Building personal friendships and sharing with the public are critical components of science diplomacy.

Notes

1. This author visited North Korea in November of 2010 following this presentation, making the total number of visits to seven.