



# North Korea's Nuclear Weapons

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## Summary

This report summarizes what is known from open sources about the North Korean nuclear weapons program—including weapons-usable fissile material and warhead estimates—and assesses current developments in achieving denuclearization.

Beginning in late 2002, North Korea ended an eight-year freeze on its plutonium production program, expelled international inspectors, and restarted facilities. North Korea may have produced enough additional plutonium for five nuclear warheads between 2002 and 2007. In total, it is estimated that North Korea has up to 50 kilograms of separated plutonium, enough for at least half a dozen nuclear weapons. While North Korea's weapons program has been plutonium-based from the start, in the last decade, intelligence has emerged pointing to a second route to a bomb using highly enriched uranium. However, the scope and success of this program may be limited, and North Korea says it does not have a uranium enrichment program.

On February 10, 2005, North Korea announced that it had manufactured nuclear weapons for self-defense and that it would bolster its nuclear weapons arsenal. In September 2005, members of the Six Party Talks (United States, South Korea, Japan, China, Russia, and North Korea) issued a Joint Statement on the verifiable denuclearization of the Korean Peninsula. On October 9, 2006, North Korea conducted a nuclear test, with a yield of under 1 kiloton. The United States and other countries condemned the test, and the United Nations Security Council passed Resolution 1718 on October 14, 2006, that requires North Korea to (1) refrain from nuclear or missile tests, (2) rejoin the Nuclear Nonproliferation Treaty (NPT), and (3) abandon its weapons of mass destruction and ballistic missile programs.

On February 13, 2007, North Korea and the other members of the Six-Party Talks agreed on steps for phased implementation of the 2005 denuclearization agreement. Phase 1 included the shut-down of plutonium production at the Yongbyon nuclear complex in exchange for an initial heavy fuel oil shipment to North Korea. Under phase 2, steps include disablement of plutonium production facilities at Yongbyon and a “complete and correct” declaration of DPRK nuclear activities, in exchange for delivery of energy assistance and removal of certain U.S. sanctions. The declaration was submitted in June 2008. Thereafter, President Bush removed North Korea from the Trading with the Enemy Act (TWEA) list and notified Congress of his intent to lift the State Sponsor of Terrorism (SST) designation after North Korea agreed to verification provisions. North Korea did not accept initial U.S. verification proposals, and in September 2008, threatened to restart reprocessing plutonium. U.S. officials announced a verbal bilateral agreement on verification in October 2008, and the Bush administration removed North Korea from the SST List. North Korea soon after said that it had not agreed to sampling at nuclear sites, a key element for future verification of plutonium production. The Six Parties met in December 2008, but did not reach agreement on verification measures. Disablement activities at Yongbyon and energy assistance deliveries continue.

Although progress has been made in disabling North Korea's plutonium production at present, the reprocessing facility at Yongbyon would take only months to restart. North Korea has thus far been unwilling to share information about its nuclear weapons production capabilities and delivery systems. Although seismographs registered the October 9, 2006 detonation and environmental sampling confirmed radioactivity, uncertainty about the weapon's design and sophistication remains. Questions also persist regarding the extent of an uranium enrichment program and past proliferation activities. This report will be updated as events warrant.

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## Latest Developments

As of the end of January 2009, the Obama Administration was undertaking a review of policy toward North Korea, including the Six Party Talks. It is expected that the Obama administration will continue the Six Party format, under which bilateral discussions are also possible. Secretary of State Hillary Clinton in her first press conference as Secretary called the Six Party Talks “essential.” In her confirmation hearing before the Senate Foreign Relations Committee on January 13, 2009, Secretary Clinton said that while she was reviewing the negotiations record to date, the goal was to end both the plutonium reprocessing program and the highly enriched uranium program if it exists, and to end North Korean proliferation to others.

Secretary of Defense Robert Gates offered his assessment in testimony before the Senate Armed Services Committee in late January:

On North Korea, the Six-Party Talks have been critical in producing some forward momentum—especially with respect to North Korea’s plutonium production—although I don’t think anyone can claim to be completely satisfied with the results so far. These talks do offer a way to curtail and hopefully eliminate its capacity to produce more plutonium or to enrich uranium, and reduce the likelihood of proliferation. Our goal remains denuclearization, but it is still to be seen whether North Korea is willing to give up its nuclear ambitions entirely.<sup>1</sup>

Speculation continued in early 2009 on Kim Jong Il’s health, the extent of succession planning, the power of the military and the seriousness with which the DPRK takes its early denuclearization promises. The Chinese media reported in late January that Kim Jong Il had told a Chinese envoy that he was committed to denuclearization and the Six Party process. However, North Korea also announced a break in agreements with the South and that it would never unilaterally disarm.<sup>2</sup>

Disablement work continued at the Yongbyon complex in January 2009 despite continuing disagreement over verification measures for the declaration. Disablement currently involves the removal of fuel rods from the reactor at Yongbyon. A shipment of heavy fuel oil was delivered to North Korea by Russia in January.

## Background

In the early 1980s, U.S. satellites tracked a growing indigenous nuclear program in North Korea. The North Korean nuclear program began in the late 1950s with cooperation agreements with the Soviet Union on a nuclear research program near Yongbyon. Its first research reactor began operation in 1967. North Korea used indigenous expertise and foreign procurements to build a small nuclear reactor at Yongbyon (5MWe). It was capable of producing about 6 kilograms (Kg) of plutonium per year and began operating in 1986.<sup>3</sup> Later that year, U.S. satellites detected high

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<sup>1</sup> Secretary of Defense Robert M. Gates, Submitted statement to the Senate Armed Services Committee, January 27, 2009. <http://armed-services.senate.gov/statemnt/2009/January/Gates%2001-27-09.pdf>

<sup>2</sup> “North Korea Refuses Unilateral Nuclear Disarmament,” Reuters, February 2, 2009. <http://uk.reuters.com/article/worldNews/idUKTRE5111UN20090202>

<sup>3</sup> 5MWe is a power rating for the reactor, indicating that it produces 5 million watts of electricity per day (very small). (continued...)

explosives testing and a new plant to separate plutonium from the reactor's spent fuel. In addition, construction of two larger reactors (50MWe at Yongbyon and 200MWe at Taechon) added evidence of a serious clandestine effort. Although North Korea had joined the Nuclear Nonproliferation Treaty (NPT) in 1985 under Soviet pressure, safeguards inspections began only in 1992, raising questions about how much plutonium North Korea had produced covertly. In 1994, North Korea pledged, under the Agreed Framework with the United States, to freeze its plutonium programs and eventually dismantle them in return for several kinds of assistance.<sup>4</sup> At that time, western intelligence agencies estimated that North Korea had separated enough plutonium for one or two bombs. North Korea complied with the Agreed Framework, allowing International Atomic Energy Agency (IAEA) seals—including the “canning” of spent fuel rods at the Yongbyon reactor—and permanent remote monitoring and inspectors at its nuclear facilities.

When in 2002, U.S. negotiators reportedly presented North Korean officials with evidence of a clandestine uranium enrichment program, the North Korean officials reportedly at first confirmed this, then denied it publicly. The conflict quickly led to the breakdown of the Agreed Framework. The Bush Administration argued that North Korea was in “material breach” of its obligations and, after agreement with South Korea, Japan, and the EU (the other members of the Korean Economic Development Organization, or KEDO), stopped the next shipment of heavy fuel oil.<sup>5</sup> In response, North Korea kicked out international monitors, broke the seals at the Yongbyon nuclear complex, and restarted its reactor and reprocessing plant after an eight-year freeze.

Members of the Six-Party Talks—the United States, South Korea, Japan, China, Russia, and North Korea—began meeting in August 2003 to try and resolve the crisis. In September 2005, the Six Parties issued a Joint Statement on how to achieve verifiable denuclearization of the Korean Peninsula, which formed the basis for future agreements.<sup>6</sup> Negotiations broke down, and North Korea tested a nuclear device in October 2006.

On February 13, 2007, North Korea reached an agreement with other members of the Six-Party Talks to begin the initial phase (60 days) of implementing the Joint Statement from September 2005 on denuclearization. Phase 1 of this agreement included the shut-down of plutonium production at the Yongbyon nuclear complex in exchange for an initial heavy fuel oil shipment to North Korea. Phase 2 steps include the disablement of facilities at Yongbyon and a “complete and correct” declaration of DPRK nuclear activities, in exchange for delivery of heavy fuel oil and equivalent, and removal of the Trading with the Enemy Act (TWEA) and State Sponsors of Terrorism (SST) designations. Still in the second phase of this plan, the United States is working with North Korea to disable key facilities. The U.S. provides funding and technical assistance for disablement activities, and the energy assistance is divided evenly between the Six Parties. North Korea submitted a declaration of its past plutonium production activities in June 2008 as agreed in an October 3, 2007, joint statement on “Second-Phase Actions.”<sup>7</sup> Thereafter, President Bush

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Reactors are also described in terms of million watts of heat (MW thermal).

<sup>4</sup> See CRS Report RL33590, *North Korea's Nuclear Weapons Development and Diplomacy*, by Larry A. Niksch and CRS Report R40095, *Assistance to North Korea*, by Mark E. Manyin and Mary Beth Nikitin.

<sup>5</sup> “Adherence To and Compliance With Arms Control, Nonproliferation and Disarmament Agreements and Commitments,” U.S. Department of State, August 2005.

<sup>6</sup> “Joint Statement of the Fourth Round of the Six-Party Talks, Beijing,” September 19, 2005, at <http://www.state.gov/r/pa/prs/ps/2005/53490.htm>.

<sup>7</sup> Second-Phase Actions for the Implementation of the September 2005 Joint Statement, October 3, 2007 <http://www.state.gov/r/pa/prs/ps/2007/oct/93223.htm>

removed North Korea from the TWEA list and notified Congress of his intent to lift the SST designation after North Korea agreed to verification provisions. North Korea did not accept initial U.S. verification proposals, and in September 2008, threatened to restart reprocessing plutonium. U.S. officials announced a bilateral agreement on verification in October 2008, and the Bush administration removed North Korea from the SST List. The agreement was verbal, and North Korea then said that it had not agreed to sampling at nuclear sites, a key element in verifying past plutonium production. The Six Parties met in December 2008, but did not reach agreement on verification measures. Disablement activities at Yongbyon and delivery of energy assistance are still in under way.

The February 2007 Denuclearization Action Plan does not address any uranium enrichment-related activities or the dismantlement of warheads and instead focuses on shutting down and disabling the key plutonium production facilities. A third phase, to begin after disablement is complete and a declaration is accepted by the Six Parties, is to deal with all aspects of North Korea's nuclear program, including weapons, using North Korea's declaration as a basis for future action. Understanding the scope of the program and the weapons capability will require transparency and careful verification for the pledged "complete, verifiable, irreversible" disarmament to be achieved.

## Weapons Production Milestones

Acquiring fissile material—plutonium-239 or highly enriched uranium (HEU)—is the key hurdle in nuclear weapons development.<sup>8</sup> Producing these two materials is technically challenging; in comparison, many experts believe weaponization to be relatively easy.<sup>9</sup> North Korea has industrial-scale uranium mining and plants for milling, refining, and converting uranium; it also has a fuel fabrication plant, a nuclear reactor, and a reprocessing plant—in short, everything needed to produce Pu-239. In its nuclear reactor, North Korea uses magnox fuel—natural uranium (>99% U-238) metal, wrapped in magnesium-alloy cladding. About 8,000 fuel rods constitute a fuel core for the reactor.

When irradiated in a reactor, natural uranium fuel absorbs a neutron and then decays into plutonium (Pu-239). Fuel that remains in the reactor for a long time becomes contaminated by the isotope Pu-240, which can "poison" the functioning of a nuclear weapon.<sup>10</sup> Spent or irradiated fuel, which poses radiological hazards, must cool after removal from the reactor. The cooling phase, estimated by some at five months, is proportional to the fuel burn-up. Reprocessing to separate plutonium from waste products and uranium is the next step. North Korea uses a PUREX separation process, like the United States. After shearing off the fuel cladding, the fuel is dissolved in nitric acid. Components (plutonium, uranium, waste) of the fuel are separated into different streams using organic solvents. In small quantities, separation can be done in hot cells, but larger quantities require significant shielding to prevent deadly exposure to radiation.<sup>11</sup>

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<sup>8</sup> Highly enriched uranium (HEU) has 20% or more U-235 isotope; 90% U-235 is weapons-grade.

<sup>9</sup> The physical principles of weaponization are well-known, but producing a weapon with high reliability, effectiveness, and efficiency without testing presents significant challenges.

<sup>10</sup> Plutonium that stays in a reactor for a long time (reactor-grade, with high "burn-up") contains about 20% Pu-240; weapons-grade plutonium contains less than 7% Pu-240.

<sup>11</sup> Hot cells are heavily shielded rooms with remote handling equipment for working with irradiated materials. For background, see Jared S. Dreicer, "How Much Plutonium Could Have Been Produced in the DPRK IRT (continued...)"

North Korea appears to have mastered the engineering requirements of plutonium production. It has operated its nuclear reactor, is believed to have separated Pu from the spent fuel, and has reportedly taken steps toward weaponization. In January 2004, North Korean officials showed an unofficial U.S. delegation alloyed “scrap” from a plutonium (Pu) casting operation.<sup>12</sup> Dr. Siegfried Hecker, a delegation member, assessed that the stated density of the material was consistent with plutonium alloyed with gallium or aluminum. If so, this could indicate a degree of sophistication in North Korea’s handling of Pu metal, necessary for weapons production. But without testing the material, Hecker could not confirm that the metal was plutonium or that it was alloyed, or when it was produced.

## Estimating Nuclear Warheads and Stocks

Secretary of State Colin Powell in December 2002 stated, “We now believe [the North Koreans] have a couple of nuclear weapons and have had them for years.”<sup>13</sup> In February 2005, North Korea officially announced that it had “manufactured nukes for self-defense.”<sup>14</sup> Although North Korea has tested one device, Vice Foreign Minister Kim Gye Gwan has previously said that North Korea possesses multiple bombs and was building more.<sup>15</sup>

A key factor in assessing how many weapons North Korea can produce is whether North Korea needs to use more or less material than the IAEA standards of 8kg of Pu and 25kg for HEU per weapon.<sup>16</sup> The amount of fissile material used in each weapon is determined by the design sophistication. There is no reliable public information on North Korean nuclear weapons design.

In all, estimates of North Korea’s separated plutonium range between 30 and 50 kg, with an approximate 5 to 6 kg of this figure having been used for the October 2006 test.<sup>17</sup> This amounts to enough plutonium for approximately five to eight nuclear weapons, assuming 6 kg per weapon. After the test, North Korea could possess plutonium for four to seven nuclear weapons. An unclassified intelligence report to Congress says that “prior to the test North Korea could have

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Reactor?” *Science and Global Security*, 2000, vol. 8, pp. 273-286, at [http://www.princeton.edu/~globsec/publications/pdf/8\\_3Dreicer.pdf](http://www.princeton.edu/~globsec/publications/pdf/8_3Dreicer.pdf).

<sup>12</sup> Alloying plutonium with other materials is “common in plutonium metallurgy to retain the delta-phase of plutonium, which makes it easier to cast and shape” (two steps in weapons production). Hecker, January 21, 2004, testimony before SFRC.

<sup>13</sup> Transcript of December 29, 2002, *Meet the Press*.

<sup>14</sup> James Brooke, “North Korea says it has atom arms It will boycott talks on ending program; arsenal called self-defense against Bush,” *The New York Times*, February 11, 2005.

<sup>15</sup> “We have enough nuclear bombs to defend against a U.S. attack. As for specifically how many we have, that is a secret.” “North Korea Admits Building More Nuclear Bombs,” *ABC News*, June 8, 2005, at <http://abcnews.go.com/WNT/story?id=831078&page=1>.

<sup>16</sup> IAEA Safeguards Glossary: [http://www-pub.iaea.org/MTCD/publications/PDF/nvs-3-cd/PDF/NVS3\\_scr.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/nvs-3-cd/PDF/NVS3_scr.pdf).

<sup>17</sup> Siegfried Hecker estimates 40-50 kg of separated plutonium and 6 kg for the test; David Albright and Paul Brannan’s study says 33-55 kg of separated plutonium and roughly 5 kg for the test. U.S. Assistant Secretary of State Christopher Hill cites 50 kg in his comments. Hecker, *ibid.* David Albright and Paul Brannan, “The North Korean Plutonium Stock February 2007,” Institute for Science and International Security, February 20, 2007. Christopher Hill, “Interview on PBS NewsHour,” October 3, 2007, at <http://www.state.gov/p/eap/rls/rm/2007/93274.htm>.

produced up to 50 kg of plutonium, enough for at least a half dozen nuclear weapons” and points out that additional plutonium is in the fuel of the Yongbyon reactor.<sup>18</sup>

Additional questions arise in determining how much plutonium North Korea has produced since 2002 when the IAEA monitors were kicked out of the country and the seals were broken at Yongbyon. A South Korean Defense Ministry white paper from December 2006 estimated that North Korea had made 30 kg of weapons-grade plutonium in the previous three years, potentially enough for five nuclear bombs. It also concurred with U.S. estimates that North Korea's total stockpile of weapons-grade plutonium was 50 kg.<sup>19</sup>

The accounting issue was further complicated when North Korea reportedly declared a lower number of 37 kg of separated plutonium in its declaration under the Six Party Talks.<sup>20</sup> No agreement has been reached on verifying the amount of plutonium stocks through inspections (see discussions on declaration, verification below). In January 2009, an American scholar who had visited Pyongyang said the North Koreans told him that 30.8 kg amount had been “weaponized,” possibly meaning that the separated plutonium might now be in warheads. The DPRK officials also told him that they would not allow for warheads to be inspected.<sup>21</sup>

## Plutonium Production

Estimates of plutonium production depend on a variety of technical factors, including the average power level of the reactor, days of operation, how much of the fuel is reprocessed and how quickly, and how much plutonium is lost in production processes. North Korean officials claimed to have separated plutonium in hot cells as early as 1975 and tested the reprocessing plant in 1990. North Korea's 5MWe nuclear reactor at Yongbyon operated from 1986 to 1994. It is estimated that North Korea produced and separated no more than 10 kg of plutonium prior to 1994.<sup>22</sup> Its plutonium production program was then frozen between 1994 and 2003 under the Agreed Framework. When this agreement was abandoned, North Korea restarted plutonium production at Yongbyon.

On February 6, 2003, North Korean officials announced that the 5MWe reactor was operating, and commercial satellite photography confirmed activity in March. In January 2004, North Korean officials told an unofficial U.S. delegation that the reactor was operating smoothly at 100% of its rated power. The U.S. visitors noted that the display in the reactor control room and steam plumes from the cooling towers confirmed operation, but that there was no way of knowing how it had operated over the last year.<sup>23</sup>

The same delegation reported that the reprocessing “facility appeared in good repair,” in contrast to a 1992 IAEA assessment of the reprocessing plant as “extremely primitive.” According to North Korean officials in January 2004, the reprocessing plant's annual throughput is 110 tons of

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<sup>18</sup> Unclassified Report to Congress on Nuclear and Missile Programs of North Korea, Office of the Director of National Intelligence, August 8, 2007.

<sup>19</sup> “North Korea ‘serious threat’ to South,” *BBC News*, <http://news.bbc.co.uk/2/hi/asia-pacific/6216385.stm>.

<sup>20</sup> Warren Strobel, “North Korean nuclear documents challenge CIA assertions,” *McClatchy Newspapers*, May 28, 2008.

<sup>21</sup> “N.K. says plutonium ‘weaponized’ and off-limits,” *The Korea Herald*, January 19, 2009.

<sup>22</sup> David Albright and Paul Brannan, “The North Korean Plutonium Stock February 2007.”

<sup>23</sup> Siegfried Hecker, January 21, 2004, testimony before Senate Foreign Relations Committee.



spent fuel, about twice the fuel load of the 5MWe reactor. Officials claimed to have reprocessed all 8,000 fuel rods from the 5MWe reactor between January and June 2003.<sup>24</sup> Reprocessing the 8,000 fuel rods would yield between 25 and 30kg of plutonium, perhaps for four to six weapons, but the exact amount of plutonium that might have been reprocessed is unknown. In 2004, North Korean officials stated that the reprocessing campaign was conducted continuously (in four six-hour shifts).

In April 2005, the 5MWe reactor was shut down, this time to harvest fuel rods for weapons.<sup>25</sup> The reactor resumed operations in June 2005.<sup>26</sup> One estimate is that the reactor held between 10 and 15 kg of Pu in April 2005, and that North Korea could have reprocessed all the fuel rods by mid-2006. From August 2005 to 2006, the reactor could have produced another 6 kg of Pu. In total, North Korea could have reprocessed enough separated plutonium for another three weapons (in addition to the estimated 4-6 bomb-worth from reprocessing the 8,000 fuel rods).<sup>27</sup> The 5MWe reactor was again shut down in July 2007, when the IAEA installed containment and surveillance measures and radiation monitoring devices.<sup>28</sup>

No construction has occurred at the 50MWe reactor at Yongbyon or at the 200MWe Taechon reactor since 2002.<sup>29</sup> They were years from completion when construction was halted. U.S. visitors in January 2004 saw heavy corrosion and cracks in concrete building structures at Yongbyon, reporting that the reactor building “looks in a terrible state of repair.”<sup>30</sup> The CIA estimated that the two reactors could generate about 275kg of plutonium per year if they were operating.<sup>31</sup> Dr. Hecker estimated that if the 50MWe reactor was functioning, it would mean a tenfold increase in North Korea's plutonium production.<sup>32</sup> North Korea agreed to halt work on reactors as part of the Six Party Talks. As of July 2007, the IAEA is monitoring to ensure that no further construction takes place at these sites.

Significant future growth in North Korea's arsenal would be possible only if the two larger reactors were completed and operating, and would depend on progress in the reported uranium enrichment program. With construction of the 50MWe and 200MWe reactors shuttered and the Yongbyon facilities awaiting disablement and eventual dismantlement, North Korean plutonium production for the moment has stopped. The reprocessing facility is also now shut down and under IAEA monitoring. However, even with the reprocessing facility shut down, North Korea could build additional warheads with existing separated plutonium because North Korea's plutonium stocks are not yet under IAEA safeguards.

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<sup>24</sup> “North Korea Says It Has Made Fuel For Atom Bombs,” *New York Times*, July 15, 2003.

<sup>25</sup> “North Koreans Claim to Extract Fuel for Nuclear Weapons,” *New York Times*, May 12, 2005.

<sup>26</sup> David Albright and Paul Brannan, “The North Korean Plutonium Stock February 2007,” Institute for Science and International Security, February 20, 2007.

<sup>27</sup> Technical difficulties associated with the fuel fabrication facility may have slowed how often the fuel was unloaded from the reactor, limiting production to at most one bomb per year. Siegfried Hecker, “Report on North Korean Nuclear Program,” Center for International Security and Cooperation, Stanford University, November 15, 2006.

<sup>28</sup> IAEA Team Confirms Shut Down of DPRK Nuclear Facilities, <http://www.iaea.org/NewsCenter/PressReleases/2007/prn200712.html>.

<sup>29</sup> Report by the Director General to the IAEA Board of Governors, “Applications of Safeguards in the Democratic People's Republic of Korea (DPRK),” GOV/2007/45-GC(51)/19, August 17, 2007.

<sup>30</sup> Hecker January 21, 2004, testimony before SRFC.

<sup>31</sup> CIA unclassified point paper distributed to congressional staff on November 19, 2002.

<sup>32</sup> Siegfried Hecker, “Report on North Korean Nuclear Program,” Center for International Security and Cooperation, Stanford University, November 15, 2006.

## A Uranium Enrichment Program?

While North Korea's weapons program has been plutonium-based from the start, in the last decade, intelligence has emerged pointing to a second route to a bomb using highly enriched uranium. There is some certainty that North Korea has parts and plans for such a program, and less certainty over how far this program has developed. The issue has been central to negotiations since October 2002, when the Bush Administration accused North Korea of having a clandestine uranium enrichment program. U.S. lead negotiator James Kelly told North Korean First Deputy Foreign Minister Kang Sok-chu that the United States had evidence of a uranium enrichment program for nuclear weapons in violation of the Agreed Framework and other agreements. James Kelly said that Kang acknowledged the existence of such a program at that meeting. However, Kang later denied this, and Foreign Minister Paek Nam Sun said that Kang had told Kelly that North Korea is "entitled" to have such a program or "an even more powerful one" to deter a pre-emptive U.S. attack.<sup>33</sup>

A 2002 unclassified CIA working paper on North Korea's nuclear weapons and uranium enrichment estimated that North Korea "is constructing a plant that could produce enough weapons-grade uranium for two or more nuclear weapons per year when fully operational—which could be as soon as mid-decade." Such a plant would need to produce more than 50kg of HEU per year, requiring cascades of thousands of centrifuges.<sup>34</sup> The paper noted that in 2001, North Korea "began seeking centrifuge-related materials in large quantities." Pakistani President Musharraf revealed in his September 2006 memoir, *In the Line of Fire*, that Abdul Qadeer Khan—chief scientist in Pakistan's nuclear weapons program who proliferated nuclear weapons technology for profit—"transferred nearly two dozen P-1 and P-2 centrifuges to North Korea. He also provided North Korea with a flow meter, some special oils for centrifuges, and coaching on centrifuge technology, including visits to top-secret centrifuge plants."<sup>35</sup> However, the United States has not been able to get direct confirmation from Khan. According to press reports, North Korea said it had imported 150 tons of high-strength aluminum tubes from Russia that could be used in a uranium enrichment program.<sup>36</sup>

Questions have been raised about whether the 2002 estimates were accurate.<sup>37</sup> In a hearing before the Senate Armed Services Committee on February 27, 2007, Joseph DeTrani, the mission manager for North Korea from the Office of the Director of National Intelligence and former chief negotiator for the Six Party Talks, was asked by Senator Jack Reed whether he had "any further indication of whether that program has progressed in the last six years, one; or two, the evidence—the credibility of the evidence that we had initially, suggesting they had a program rather than aspirations?" DeTrani responded that "the assessment was with high confidence that,

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<sup>33</sup> Selig Harrison, "Did North Korea Cheat?" *Foreign Affairs*, vol. 84, no. 1, January/February 2005.

<sup>34</sup> North Korea would first have to convert uranium "yellowcake" into uranium hexafluoride to feed into the centrifuges. The centrifuges would "enrich" the uranium, or increase the portion of U-235. Weapons-grade enriched uranium according to the IAEA needs to have an enrichment level of at least 20%. See CRS Report RL34234, *Managing the Nuclear Fuel Cycle: Policy Implications of Expanding Global Access to Nuclear Power*, by Mary Beth Nikitin, Anthony Andrews, and Mark Holt.

<sup>35</sup> Pervez Musharraf, *In the Line of Fire: A Memoir*, (New York: Free Press, September 2006), p. 296.

<sup>36</sup> "NK Admits to Buying Aluminum Tubes," KBS World News, September 27, 2007, and Takashi Sakamoto, "DPRK Admits To Importing Aluminium Tubes From Russia for Uranium Enrichment," *Yomiuri Shinbun*, in Japanese, Translated by *BBC Monitoring Asia Pacific*, October 26, 2007.

<sup>37</sup> Paul Kerr, "News Analysis: Doubts Rise on North Korea's Uranium-Enrichment Program," *Arms Control Today*, April 2007, at [http://www.armscontrol.org/act/2007\\_04/NewsAnalysis.asp](http://www.armscontrol.org/act/2007_04/NewsAnalysis.asp).

indeed, they were making acquisitions necessary for, if you will, a production-scale program. And we still have confidence that the program is in existence—at the mid-confidence level.” In a clarification of his response, DeTrani issued a DNI press release that said there was a high level of confidence in 2002 that North Korea had a uranium enrichment program, and “at least moderate confidence that North Korea’s past efforts to acquire a uranium enrichment capability continue today.”<sup>38</sup> Assistant Secretary of State Christopher Hill said in February 2007 that the United States is not sure if North Korea has mastered “some considerable production techniques,” although they have acquired some technology for an enrichment program.<sup>39</sup>

A DNI unclassified report of August 2007 stated,

We continue to assess with high confidence that North Korea has pursued efforts to acquire a uranium enrichment capability, which we assess is intended for nuclear weapons. All Intelligence Community agencies judge with at least moderate confidence that this past effort continues. The degree of progress towards producing enriched uranium remains unknown, however.<sup>40</sup>

In testimony to Congress on February 2008, Director of National Intelligence Michael McConnell confirmed this assessment. The confidence level of these assessments may have changed because of a decrease in international procurement by North Korea. Uranium enrichment-related imports would be more easily detected by intelligence agencies than activities inside North Korea itself. Uranium enrichment facilities can be hidden from aerial surveillance more easily than plutonium facilities, making it more difficult for intelligence agencies to even detect—thus, “degree of progress” in turning the equipment into a working enrichment program is “unknown.” Furthermore, there are significant differences between assembling a small-scale centrifuge enrichment program and operating a large-scale production plant, and reportedly little evidence of procurement for a large-scale plant has emerged.<sup>41</sup> Dr. Siegfried Hecker has assessed that it is “highly likely that North Korea had a research and development uranium enrichment effort, but there is little indication that they were able to bring it to industrial scale.”<sup>42</sup>

North Korea reportedly continues to deny the existence of a highly enriched uranium program for weapons. In 2007, North Korea gave the United States a sample of the aluminum tubing in an effort to prove that it never intended to produce highly enriched uranium for weapons, and that the imported materials were for conventional weapons or dual-use projects. However, when U.S. scientists analyzed the aluminum tubing provided as sample “evidence,” they found traces of

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<sup>38</sup> “There has been considerable misinterpretation of the Intelligence Community’s view of North Korean efforts to pursue a uranium enrichment capability. The intelligence in 2002 was high quality information that made possible a high confidence judgment about North Korea’s efforts to acquire a uranium enrichment capability. The Intelligence Community had then, and continues to have, high confidence in its assessment that North Korea has pursued that capability. We have continued to assess efforts by North Korea since 2002. All Intelligence Community agencies have at least moderate confidence that North Korea’s past efforts to acquire a uranium enrichment capability continue today.” ODNI News Release 04-07, March 4, 2007, at [http://www.dni.gov/press\\_releases/20070304\\_release.pdf](http://www.dni.gov/press_releases/20070304_release.pdf).

<sup>39</sup> “Update on the Six Party Talks,” *Brookings Institution*, February 22, 2007, at <http://www.brookings.edu/events/2007/0222south-korea.aspx>.

<sup>40</sup> Unclassified Report to Congress on Nuclear and Missile Programs of North Korea, Office of the Director of National Intelligence, August 8, 2007.

<sup>41</sup> See David Albright, “North Korea’s Alleged Large-Scale Enrichment Plant: Yet Another Questionable Extrapolation Based on Aluminum Tubes,” *The Institute for Science and Security*, February 23, 2007, at <http://www.isis-online.org/publications/dprk/DPRKenrichment22Feb.pdf>.

<sup>42</sup> Siegfried Hecker, “Denuclearizing North Korea,” *Bulletin of the Atomic Scientists*, May/June 2008.

enriched uranium on the tubing. Analysts argue that in addition to the possibility that this is proof of a North Korean uranium enrichment program, it is also possible that the uranium traces could have been on the tubing when North Korea received it.<sup>43</sup>

In 2008, U.S. personnel found traces of highly-enriched uranium on the documents submitted as part of North Korea's nuclear declaration, raising new doubts about the extent of North Korea's uranium enrichment program.<sup>44</sup> Ambassador Hill told Congress that North Korea included as part of its June 2008 "declaration package" a letter that says that "they do not now and will not in the future have a highly enriched uranium program."<sup>45</sup> This issue remains unresolved.

## The October 9, 2006, Nuclear Test<sup>46</sup>

The U.S. Director of National Intelligence confirmed that North Korea conducted an underground nuclear explosion on October 9, 2006, in the vicinity of P'unggye.<sup>47</sup> However, the sub-kiloton yield of the test suggests that the weapon design or manufacturing process likely needs improvement.<sup>48</sup> North Korea reportedly told China before the test that it expected a yield of 4 kilotons, but seismic data confirmed that the yield was less than 1 kt.<sup>49</sup> Radioactive debris indicates that the explosion was a nuclear test, and that a plutonium device was used.<sup>50</sup> It is widely believed that the warhead design was an implosion device.<sup>51</sup> Uncertainties remain about when the plutonium used for the test was produced and how much plutonium was in the device, although a prominent U.S. nuclear scientist has estimated that North Korea likely used approximately 6 kg of plutonium for the test.<sup>52</sup>

The test's low yield may not have been a failure. Another possibility is that the test's low yield was intentional—a sophisticated device designed for a Nodong medium range missile.

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<sup>43</sup> Glenn Kessler, "Uranium Traces Found on N. Korean Aluminum Tubes," *Washington Post*, December 21, 2007, at [http://www.washingtonpost.com/wp-dyn/content/article/2007/12/20/AR2007122002196\\_pf.html](http://www.washingtonpost.com/wp-dyn/content/article/2007/12/20/AR2007122002196_pf.html).

<sup>44</sup> Glenn Kessler, "New Data Found On North Korea's Nuclear Capacity; Intelligence on Enriched Uranium Revives Questions About Weapons," *The Washington Post*, June 21, 2008.

<sup>45</sup> Senate Armed Services Hearing on the North Korean Six-Party Talks and Implementation Activities, July 31, 2008.

<sup>46</sup> See also CRS Report RL33709, *North Korea's Nuclear Test: Motivations, Implications, and U.S. Options*, by Emma Chanlett-Avery and Sharon Squassoni.

<sup>47</sup> "Analysis of air samples collected on October 11, 2006 detected radioactive debris which confirms that North Korea conducted an underground nuclear explosion in the vicinity of P.unggye on October 9, 2006. The explosion yield was less than a kiloton." ODNI News Release No. 19-06, at [http://www.dni.gov/announcements/20061016\\_release.pdf](http://www.dni.gov/announcements/20061016_release.pdf).

<sup>48</sup> By comparison, a simple plutonium implosion device normally would produce a larger blast, perhaps 5 to 20 kilotons. The first nuclear tests conducted by other states range from 9 kt (Pakistan) to 60kt (France), but tests by the United States, China, Britain, and Russia were in the 20kt-range.

<sup>49</sup> Mark Mazzetti, "Preliminary Samples Hint at North Korean Nuclear Test," *New York Times*, October 14, 2006, at <http://www.nytimes.com/2006/10/14/world/asia/14nuke.html>.

<sup>50</sup> Thom Shanker and David Sanger, "North Korean fuel identified as plutonium," *New York Times*, October 17, 2006, at <http://www.nytimes.com/2006/10/17/world/asia/17diplo.html>. A debate on this issue can be found in the November 2006 issue of *Arms Control Today*, at [http://armscontrol.org/act/2006\\_11/tech.asp#Sidebar1](http://armscontrol.org/act/2006_11/tech.asp#Sidebar1).

<sup>51</sup> Implosion devices, which use sophisticated lenses of high explosives to compress fissile material, are generally thought to require testing, although the CIA suggested in 2003 that North Korea could validate a simple fission nuclear weapons design using extensive high explosives testing. CIA response to questions for the record, August 18, 2003, submitted by the Senate Select Committee on Intelligence, at [http://www.fas.org/irp/congress/2003\\_hr/021103qfr-cia.pdf](http://www.fas.org/irp/congress/2003_hr/021103qfr-cia.pdf).

<sup>52</sup> Siegfried Hecker, "Report on North Korean Nuclear Program," Center for International Security and Cooperation, Stanford University, November 15, 2006.

Alternatively, a low yield could have been intended to avoid radioactive leakage from the test site or to limit the amount of plutonium used.<sup>53</sup>

## Delivery Systems

Although former Defense Intelligence Agency (DIA) Director Lowell Jacoby told the Senate Armed Services Committee in April 2005 that North Korea had the capability to arm a missile with a nuclear device, Pentagon officials later backtracked from that assessment. A DNI report to Congress says that “North Korea has short and medium range missiles that could be fitted with nuclear weapons, but we do not know whether it has in fact done so.”<sup>54</sup> North Korea has several hundred short-range Scud-class and medium range No Dong-class ballistic missiles, and is developing an intermediate range ballistic missile. The Taepo-Dong-2 that was tested unsuccessfully in July 2006 would be able to reach the continental United States if it becomes operational. DNI assessed in 2008 that the Taepo-Dong-2 has the potential capability to deliver a nuclear-weapon-sized payload to the United States, but that absent successful testing the likelihood of this is low.<sup>55</sup>

It is possible that Pakistani scientist A.Q. Khan may have provided North Korea the same Chinese-origin nuclear weapon design he provided to Libya and Iran. Even though that design was for an HEU-based device, it would still help North Korea develop a reliable warhead for ballistic missiles—small, light, and robust enough to tolerate the extreme conditions encountered through a ballistic trajectory. Learning more about what is needed for miniaturization of warheads for ballistic missiles could have been the goal of North Korea’s testing a smaller nuclear device.<sup>56</sup>

## Doctrine and Intent

U.S. officials in their threat assessments have described the North Korean nuclear capabilities as being more for deterrence and coercive diplomacy than for warfighting, and assess that Pyongyang most likely would “not attempt to use nuclear weapons against U.S. forces or territory unless it perceived the regime to be on the verge of military defeat and risked an irretrievable loss of control.”<sup>57</sup> Statements by North Korean officials emphasize that moves to expand their nuclear arsenal are in response to perceived threats by the United States against the North Korean regime.<sup>58</sup> Nuclear weapons also give North Korea leverage in diplomatic negotiations, and threatening rhetoric often coincides with times of crisis or transitions in negotiations. In January

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<sup>53</sup> Ibid.

<sup>54</sup> Unclassified Report to Congress on Nuclear and Missile Programs of North Korea, Office of the Director of National Intelligence, August 8, 2007. Also see CRS Report RS21473, *North Korean Ballistic Missile Threat to the United States*, by Steven A. Hildreth.

<sup>55</sup> Annual Threat Assessment of the Director of National Intelligence for the Senate Select Committee on Intelligence, February 5, 2008, at [http://www.dni.gov/testimonies/20080205\\_testimony.pdf](http://www.dni.gov/testimonies/20080205_testimony.pdf).

<sup>56</sup> “Technical Perspective on North Korea’s Nuclear Test: A Conversation between Dr. Siegfried Hecker and Dr. Gi-Wook Shin,” Stanford University website, October 10, 2006, at [http://aparc.stanford.edu/news/technical\\_perspective\\_on\\_north\\_koreas\\_nuclear\\_test\\_a\\_conversation\\_between\\_dr\\_siegfried\\_hecker\\_and\\_dr\\_giwook\\_shin\\_20061010/](http://aparc.stanford.edu/news/technical_perspective_on_north_koreas_nuclear_test_a_conversation_between_dr_siegfried_hecker_and_dr_giwook_shin_20061010/).

<sup>57</sup> Annual Threat Assessment of the Director of National Intelligence for the Senate Select Committee on Intelligence, February 5, 2008, at [http://www.dni.gov/testimonies/20080205\\_testimony.pdf](http://www.dni.gov/testimonies/20080205_testimony.pdf).

<sup>58</sup> See, for example, North Korea’s statement of February 10, 2005, at <http://news.bbc.co.uk/2/hi/asia-pacific/4252515.stm>.

2008, a North Korean media report stated that the country “will further strengthen our war deterrent capabilities in response to U.S. attempts to initiate nuclear war,” to express its displeasure that it had not yet been removed from the U.S. terrorism list.<sup>59</sup> Statements from Pyongyang in January 2009 may also be part of a strategy to increase leverage in nuclear talks.<sup>60</sup>

## Steps Toward Denuclearization

In September 2005, North Korea agreed to abandon “all nuclear weapons and existing nuclear programs,” but implementation of this goal was stalled.<sup>61</sup> The October 9, 2006, nuclear test is seen as a catalyst in uniting the other members of the Six Party Talks to toughen their stance towards North Korea, and as a turning point in Pyongyang’s attitude. UN Security Council Resolution 1718 calls on North Korea to abandon its nuclear weapons in a “complete, verifiable, and irreversible manner.”<sup>62</sup> In February 2007, as part of implementation of the September 2005 Joint Statement, North Korea committed to disable all nuclear facilities and provide a “complete and correct” declaration of all its nuclear programs.<sup>63</sup>

## Disablement

The October 2007 Six-Party joint statement said the United States would lead disablement activities and provide the initial funding for those activities.<sup>64</sup> Disablement indicates a physical measure to make it difficult to restart operation of a facility while terms are being worked out for its eventual dismantlement. U.S. officials have said that they would prefer a disablement process that would require a 12-month time period to start up the facility again.<sup>65</sup> The Six Parties have agreed to 11 discrete steps to disable the three main Yongbyon facilities related to North Korea’s plutonium program (nuclear fuel fabrication plant, plutonium reprocessing plant, and 5-megawatt experimental nuclear power reactor).<sup>66</sup> The disablement process began in early November 2007 and continues today. The most time-consuming step is the removal of the irradiated fuel from the reactor to storage in an adjacent cooling pond.<sup>67</sup> A reported eight out of eleven steps have been completed (see **Table 1**).<sup>68</sup>

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<sup>59</sup> “North Korea says nuclear declaration submitted,” *Reuters*, January 4, 2008.

<sup>60</sup> Blaine Harden, “With Obama in the White House, North Korea Steps Up Big Talk,” *Washington Post*, February 3, 2009.

<sup>61</sup> Joint Statement of the Fourth Round of Six Party Talks, Beijing, September 19, 2005, at <http://www.state.gov/r/pa/prs/ps/2005/53490.htm>.

<sup>62</sup> United Nations Security Council Resolution 1718, October 14, 2006, at <http://daccessdds.un.org/doc/UNDOC/GEN/N06/572/07/PDF/N0657207.pdf?OpenElement>.

<sup>63</sup> “Denuclearization Action Plan,” February 13, 2007, at <http://merln.ndu.edu/archivepdf/northkorea/state/80479.pdf>.

<sup>64</sup> Second Phase Actions for the Implementation of the September 2005 Joint Statement, October 3, 2007, at <http://www.state.gov/r/pa/prs/ps/2007/oct/93223.htm>.

<sup>65</sup> On-the-Record-Briefing, U.S. Assistant Secretary of State Christopher Hill, October 3, 2007, at <http://www.state.gov/p/eap/rls/rm/2007/93234.htm>.

<sup>66</sup> “North Korea ‘Agrees to Nuclear Disablement Procedure,’” *Chosun Ilbo*, October 27, 2007.

<sup>67</sup> David Albright and Paul Brannan, “Disabling DPRK Nuclear Facilities,” United States Institute of Peace Working Paper, October 23, 2007.

<sup>68</sup> See charts at “North Korean Disablement Actions,” *Arms Control Today*, October 2008; “Disablement Actions,” National Committee on North Korea website.

Table I. Disablement Steps at Yongbyon, DPRK

Step	Facility	Status
Discharge of 8000 spent fuel rods to the spent fuel pool	5-megawatt reactor	On-going; 6,100 completed as of February 2009
Removal of control rod drive mechanisms	5-megawatt reactor	To be done after spent fuel removal is completed
Removal of reactor cooling loop and wooden cooling tower interior structure	5-megawatt reactor	Tower demolished June 26, 2008
Disablement of fresh fuel rods	Fuel fabrication facility	Not agreed to by North Korea; consultations held Jan. 2009 with South Korea on possibility of purchase
Removal and storage of 3 uranium ore concentrate dissolver tanks	Fuel fabrication facility	Completed
Removal and storage of 7 uranium conversion furnaces, including storage of refractory bricks and mortar sand	Fuel fabrication facility	Completed
Removal and storage of both metal casting furnaces and vacuum system, and removal and storage of 8 machining lathes	Fuel fabrication facility	Completed
Cut cable and remove drive mechanism associated with the receiving hot cell door	Reprocessing facility	Completed
Cut two of four steam lines into reprocessing facility	Reprocessing facility	Completed
Removal of drive mechanisms for the fuel cladding shearing and slitting machines	Reprocessing facility	Completed
Removal of crane and door actuators that permit spent fuel rods to enter the reprocessing facility	Reprocessing facility	Completed

**Source:** "North Korean Disablement Actions," *Arms Control Today*, October 2008; "Disablement Actions," National Committee on North Korea website; Siegfried Hecker, "Denuclearizing North Korea," *Bulletin of the Atomic Scientists*, May/June 2008.

North Korea has periodically slowed the pace of spent fuel rod removal at Yongbyon.<sup>69</sup> For example, in June 2008, Pyongyang said that while 80% of the disablement steps had been completed, only 36% of energy aid had been delivered.<sup>70</sup> North Korea again delayed disablement work in August, September, and October 2008, although those instances appear to be linked to disputes over when the U.S. would remove the DPRK from its State Sponsors of Terrorism List and negotiations over verification measures. After the U.S. removed the SST designation, disablement work resumed in October 2008.

<sup>69</sup> "N.Korea 'Slowing Disablement of Nuclear Facilities,'" *Chosun Ilbo*, January 29, 2008.

<sup>70</sup> Lee Chi-dong, "N Korea Complains About Slow Provision of Energy Aid," *Yonhap News*, June 5, 2008.

The extent to which the Yongbyon facilities have been disabled was tested in September 2008 when North Korea halted international monitoring at the reprocessing facility, moved some equipment out of storage, and threatened to begin reprocessing again.<sup>71</sup> This temporary reversal was corrected and equipment moved back to storage by November 2008. Experts have estimated that restarting the reprocessing plant could take approximately 6 to 8 weeks. It would take approximately three to four months to reprocess the spent fuel rods now in storage at Yongbyon, resulting in 7 to 8 kg of plutonium. This would be enough for at least one nuclear weapon.<sup>72</sup> According to reports, disablement was limited to the “front-end,” where spent fuel is loaded, at the reprocessing facility for technical reasons related to the safe disposal of the high-level waste in the facility. The waste treatment facilities in the “back-end” of the reprocessing facility may need to be restarted in the next year to allow for the safe disposal of this waste.<sup>73</sup>

The remaining steps to accomplish in disabling the Yongbyon facilities are to finish the removal of the spent fuel rods from the 5 megawatt reactor, remove the control rod drive mechanism (after all rods are removed), and disable the fresh fuel rods at the site. As of February 2009, 6,100 spent fuel rods have been moved from the reactor to the cooling pond. There are fresh fuel rods for both the 5 megawatt reactor and the planned 50 megawatt reactor in storage at Yongbyon. A technical delegation from South Korea visited the facility in January 2009 to consider possibilities for removing the fuel rods. Another option would be to bend them so they could not be readily used in the reactor.<sup>74</sup> It is not clear whether North Korea has agreed to disablement or removal of the fresh fuel.

## Declaration

The required content of a “complete and correct” declaration has evolved over time. Bush administration officials in fall 2007 said they expected the declaration to include a full declaration of the separated weapons-grade plutonium that has already been produced, as well as full disclosure of uranium enrichment activities.<sup>75</sup> The North Korean Foreign Ministry said on January 4, 2008 that it had notified the United States of the content of its declaration in November 2007. However, Assistant Secretary Hill said that the two sides had discussed what was expected to be in a declaration, and “it was clearly not a complete and correct declaration.”<sup>76</sup> At that time, North Korea reportedly suggested it would declare 30 kg of separated plutonium in its declaration, a lower number than U.S. officials have alluded to (see above) but in the range of some analyses.<sup>77</sup> The United States has said that “materials, facilities and programs” need to be

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<sup>71</sup> IAEA Press Release, “IAEA Removes Seals at Yongbyon,” September 24, 2008.

<sup>72</sup> Peter Crail, “North Korea Moves to Restart Key Nuclear Plant,” *Arms Control Today*, October 2008.

<sup>73</sup> For a discussion of the pro’s and con’s see sidebar “A Diplomatic and Technological Cocktail,” *Bulletin of the Atomic Scientists*, May/June 2008, p.49.

<sup>74</sup> “MOFAT Reveals North Korean Fuel Rod Images,” *Daily North Korea*, February 4, 2009. <http://www.dailynk.com/english/read.php?cataId=nk03100&num=4516>

<sup>75</sup> On-The-Record Briefing: Assistant Secretary of State for East Asian and Pacific Affairs and Head of the U.S. Delegation to the Six-Party Talks Christopher R. Hill, October 3, 2007, at <http://www.state.gov/p/eap/rls/rm/2007/93234.htm>.

<sup>76</sup> Joint Press Availability, Assistant Secretary of State Christopher R. Hill, January 7, 2008. <http://www.state.gov/p/eap/rls/rm/2008/01/98756.htm>

<sup>77</sup> David Albright, Paul Brannan, and Jacqueline Shire, “North Korea’s Plutonium Declaration: A Starting Point for an Initial Verification Process,” The Institute for Science and International Security, January 10, 2008. <http://www.isis-online.org/publications/dprk/NorthKoreaDeclaration10Jan2008.pdf>



included in a declaration. In addition to plutonium stocks, North Korea agreed to “address concerns about a uranium enrichment program but denies that it has one” (see below). Other outstanding issues are nuclear proliferation activities and warhead information. North Korea has said it would not include warhead information at this stage. Once the original December 31 deadline for submission of the declaration had passed, U.S. officials emphasized that the completeness of the document was more important than its timing. U.S. officials also made statements in early 2008 that removal from sanctions lists would only happen after a complete declaration was submitted to the six parties.

According to press reports,<sup>78</sup> at a bilateral meeting in Singapore in April 2008, the United States and North Korea agreed to a formulation in which North Korea would include its plutonium production activities in a formal declaration, and the enrichment and proliferation issues would be dealt with separately in a secret side agreement in which North Korea would “acknowledge” the U.S. concerns over North Korean proliferation to Syria without confirming or denying them. This agreement is also supposed to have included a pledge by North Korea that it would not engage in any future nuclear proliferation. Administration officials in spring 2008 emphasized that ending plutonium production and tallying the plutonium stockpile were the highest priorities. However, concerns were raised in the Congress and elsewhere by those skeptical of this approach, with some observers wanting assurance that the North Korean declaration of its plutonium stockpile would be adequately verified before the United States removed them from the State Sponsors of Terrorism List.

On May 8, 2008, North Korean officials gave State Department Korean Affairs Director Sung Kim approximately 19,000 pages of documentation related to its nuclear program. According to a State Department fact sheet, the documents consist of operating records for the five-megawatt reactor [5-MW(e)] and fuel reprocessing plant at the Yongbyon nuclear complex, dating back to 1986. They reportedly include reactor operations and information on all three reprocessing campaigns undertaken by North Korea.<sup>79</sup> As referenced above, press reports indicated that U.S. personnel had found traces of highly-enriched uranium on these documents, raising new doubts about the extent of North Korea's uranium enrichment program at a sensitive juncture in the negotiations.<sup>80</sup>

On June 26, 2008, North Korea submitted a declaration of its nuclear programs to China, the Chair of the Denuclearization Working Group. Ambassador Christopher Hill said in testimony to Congress that the “declaration package” addresses “its plutonium program, and acknowledged our concerns about the DPRK's uranium enrichment and nuclear proliferation activities, specifically with regard to Syria.”<sup>81</sup> Press reports have said that North Korea submitted a list of nuclear sites and declared 37 kg of plutonium in the 60-page document. The confidential message

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<sup>78</sup> See, for example, Helene Cooper, “Past Deals by N. Korea May Face Less Study,” *The New York Times*, April 18, 2008. [http://www.nytimes.com/2008/04/18/washington/18diplo.html?\\_r=2&adxnnl=1&oref=slogin&ref=world&adxnnlx=1208545358-9gpsLj35wtiPmoT8RHM6mQ](http://www.nytimes.com/2008/04/18/washington/18diplo.html?_r=2&adxnnl=1&oref=slogin&ref=world&adxnnlx=1208545358-9gpsLj35wtiPmoT8RHM6mQ) and Glenn Kessler, “U.S. Ready to Lift Sanctions on North Korea,” *The Washington Post*, April 11, 2008. [<http://www.washingtonpost.com/wp-dyn/content/article/2008/04/10/AR2008041004082.html?nav=emailpage>]

<sup>79</sup> “Update on the Six-Party Talks,” State Department Fact Sheet, May 10, 2008. [<http://www.state.gov/r/pa/prs/ps/2008/may/104558.htm>]

<sup>80</sup> Glenn Kessler, “New Data Found On North Korea's Nuclear Capacity; Intelligence on Enriched Uranium Revives Questions About Weapons,” *The Washington Post*, June 21, 2008.

<sup>81</sup> Statement of Christopher R. Hill, Assistant Secretary of State, Bureau of East Asian and Pacific Affairs, U.S. Department of State, to the Senate Committee on Armed Services, July 31, 2008.

acknowledging U.S. concerns about uranium enrichment and proliferation activities was received days earlier.<sup>82</sup> In response, also on June 26, 2008, President Bush announced that the Trading with the Enemy Act (TWEA) would no longer apply to North Korea and notified Congress of his intent to remove North Korea's designation as a State Sponsor of Terrorism (SST) after the required 45-day wait period.<sup>83</sup> The day after the declaration was submitted the U.S. assisted North Korea in destroying the cooling tower at the 5-megawatt reactor at Yongbyon. Subsequent verification issues are discussed below.

## Verification

IAEA inspectors returned to North Korea in July 2007 to monitor and verify the shut-down, install seals, and monitor facilities at the Yongbyon nuclear complex, and have had a continuous presence there since then.<sup>84</sup> In his September 10, 2007, statement to the IAEA Board of Governors, Director General Mohamed ElBaradei stated that the IAEA was able to verify the shutdown of nuclear facilities, including the nuclear fuel fabrication plant, radio-chemical laboratory (reprocessing plant), and the 5MWe experimental nuclear power reactor. Inspectors are also monitoring the halt in construction of the 50-megawatt nuclear power plant at Yongbyon and the 200-megawatt nuclear power plant in Taechon.<sup>85</sup> The United States has contributed \$1.8 million as the U.S. voluntary contribution and Japan has contributed \$500,000 to the IAEA for their work in North Korea.<sup>86</sup> In the future, the IAEA may be called on to investigate North Korea's past nuclear program in addition to monitoring activities; however, to date, its role has been limited to monitoring the shut-down of Yongbyon facilities. The IAEA's role in disablement and future dismantlement efforts has yet to be clearly determined. Some analysts recommend an observer role for the IAEA during disablement steps and continued IAEA monitoring to boost international confidence in the process.<sup>87</sup> The United States and North Korea reportedly agreed on an "consultative and support" role for the IAEA in future verification in October 2008.<sup>88</sup>

Since IAEA inspectors were expelled from North Korea in 2002, information about North Korea's nuclear weapons production has depended on remote monitoring and defector information, with mixed results. Satellite images correctly indicated the start-up of the 5MWe reactor, but gave no details about its operations. Satellites also detected trucks at Yongbyon in late January 2003, but could not confirm the movement of spent fuel to the reprocessing plant;<sup>89</sup> imagery reportedly detected activity at the reprocessing plant in April 2003, but could not confirm

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<sup>82</sup> Glenn Kessler, "Message to US Preceded North Korean Nuclear Declaration," *The Washington Post*, July 2, 2008.

<sup>83</sup> [<http://www.whitehouse.gov/news/releases/2008/06/20080626-4.html>]; [<http://www.state.gov/r/pa/prs/ps/2008/jun/106281.htm>]

<sup>84</sup> "IAEA Team Confirms Shut Down of DPRK Nuclear Facilities," IAEA press release, July 18, 2007, a t <http://www.iaea.org/NewsCenter/PressReleases/2007/prn200712.html>.

<sup>85</sup> GOV/2007/45-GC(51)/19, August 17, 2007.

<sup>86</sup> Statement of Christopher R. Hill Assistant Secretary, Bureau of East Asian and Pacific Affairs, Department of State before the House Committee on Foreign Affairs, Subcommittee on Asia, the Pacific and the Global Environment and Subcommittee on Terrorism, Nonproliferation and Trade, Joint Hearing on the North Korea Six-Party Process, October 25, 2007.

<sup>87</sup> North Korea reportedly did not want the IAEA involved and wanted the United States to do the disabling. Albright and Brannan, *ibid*.

<sup>88</sup> "U.S.-North Korea Understandings on Verification," October 11, 2008. <http://2001-2009.state.gov/r/pa/prs/ps/2008/oct/110924.htm>

<sup>89</sup> "Reactor Restarted, North Korea Says," *Washington Post*, February 6, 2003.

large-scale reprocessing;<sup>90</sup> and satellite imagery could not peer into an empty spent fuel pond, which was shown to U.S. visitors in January 2004. North Korean officials stated in 2004 that the reprocessing campaign was conducted continuously (four six-hour shifts). U.S. efforts to detect Krypton-85 (a by-product of reprocessing) reportedly suggested that some reprocessing had taken place, but were largely inconclusive. Even U.S. scientists visiting Pyongyang in January 2004 could not confirm North Korean claims of having reprocessed the spent fuel or that the material shown was in fact plutonium. These are some of the uncertainties verification measures will seek to answer.

Verification received increased attention in the Six Party process beginning in spring 2008. Statements made by President Bush and Secretary of State Rice in June 2008 further demonstrated that the U.S. administration was linking SST removal with progress on verification issues.<sup>91</sup> U.S. officials have said there have been spoken agreements with the North Koreans saying that the only way the declaration can be deemed “complete and correct” is if it verifiable.

The State Department said in a June 26 fact sheet that by submitting the declaration, North Korea had “begun to fulfill its declaration commitment.” The fact sheet also stated that a comprehensive verification regime would include “short notice access to declared or suspect sites related to the North Korean nuclear program, access to nuclear materials, environmental and bulk sampling of materials and equipment, interviews with personnel in North Korea, as well as access to additional documentation and records for all nuclear related facilities and operations.” It also said that the actual rescission of North Korea’s designation as a State Sponsor of Terrorism will occur only after “the Six Parties reach agreement on acceptable verification principles and an acceptable verification protocol; the Six Parties have established an acceptable monitoring mechanism; and verification activities have begun.”<sup>92</sup>

On July 12, the Six Parties agreed unanimously to principles for a “verification mechanism” for the denuclearization of the Korean Peninsula, to be detailed by the denuclearization working group.<sup>93</sup> Thereafter, U.S. negotiators submitted a proposed verification protocol to North Korea called the “Verification Measures Discussion Paper” which outlined extensive measures to verify all aspects of North Korea’s nuclear programs, including plutonium production, uranium enrichment, weapons, weapons production and testing, and proliferation activities.<sup>94</sup> North Korea reportedly submitted a counter-proposal that objected to provisions related to inspections at undeclared facilities and the taking of samples.

The 45-day wait period for the SST List removal ended on August 11, but the administration did not take action. On August 26, the North Korean news agency announced it had suspended disablement activities at Yongbyon as of August 14 since the United States had not removed it from the terrorism list. The North Korean Foreign Ministry statement said that the agreement had been to delist North Korea once it had submitted a declaration of its nuclear programs, not once

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<sup>90</sup>“US Suspects North Korea Moved Ahead on Weapons,” *New York Times*, May 6, 2003.

<sup>91</sup> “President Bush Discusses North Korea,” White House press release, June 26, 2008; Condoleezza Rice, “U.S. Policy Toward Asia,” Heritage Foundation speech, June 18, 2008.

<sup>92</sup> “North Korea: Presidential Action on State Sponsor of Terrorism (SST) and the Trading with the Enemy Act (TWEA), State Department Fact Sheet, June 26, 2008. [<http://www.state.gov/r/pa/prs/ps/2008/jun/106281.htm>]

<sup>93</sup> Press Communique of the Heads of Delegation Meeting of the Sixth Round of the Six-Party Talks, Beijing, July 12, 2008. [[http://www.mofa.go.jp/region/asia-paci/n\\_korea/6party/press0807.html](http://www.mofa.go.jp/region/asia-paci/n_korea/6party/press0807.html)]

<sup>94</sup> This paper was made public by the Washington Post. Glenn Kessler, “Far-Reaching U.S. Plan Impaired North Korea Deal,” *The Washington Post*, September 26, 2008.

verification measures had been agreed upon. It said, "As far as the verification is concerned, it is a commitment to be fulfilled by the six parties at the final phase of the denuclearization of the whole Korean Peninsula according to the September 19 joint statement.... All that was agreed upon at the present phase was to set up verification and monitoring mechanisms within the framework of the six parties."<sup>95</sup> The statement also threatened to restore facilities at Yongbyon.

On Monday, September 22, North Korea asked the International Atomic Energy Agency (IAEA) personnel monitoring the shut-down of facilities at the Yongbyon nuclear complex to remove the seals and surveillance equipment from the plutonium reprocessing plant. North Korea informed the IAEA that inspectors would no longer have access to that facility. IAEA inspectors and U.S. Department of Energy personnel located at Yongbyon were not expelled from the Yongbyon site, and other monitoring and inspection activities related to disablement continued. However, North Korea told the IAEA that it planned to "introduce nuclear material to the reprocessing plant in one week's time."<sup>96</sup>

These actions were reversed when, in early October, the US and North Korea agreed on a "verification mechanism" to determine the accuracy of the DPRK's declaration of its plutonium production. Ambassador Hill traveled to Pyongyang October 2-3 for further bilateral talks on the verification agreement. As a result of these talks, the US and DPRK reached agreement on verification measures. Although the document has not yet been made public, according to State Department officials North Korea has agreed to: the US taking samples out of country for review; visits to all declared sites and to undeclared sites by mutual consent; participation of South Korea and Japan in verification; and a consultative role for the IAEA.<sup>97</sup> They also agreed that "all measures contained in the Verification Protocol will apply to the plutonium-based program and any uranium enrichment and proliferation activities." According to the State Department's fact sheet on the agreement, the measures are "codified in a joint document between the United States and North Korea and certain other understandings." Many observers interpret "other understandings" as referring to verbal agreements or separate documents, but neither the United States nor North Korea have made this clear. The United States removed North Korea from the State Sponsors of Terrorism List on October 11.

Then-Presidential candidate Barack Obama issued a statement after the October 11, 2008 SST list removal that emphasized strong verification measures:

"If North Korea refuses to permit robust verification, we should lead all members of the Six Party talks in suspending energy assistance, re-imposing sanctions that have recently been waived, and considering new restrictions. Our objective remains the complete and verifiable elimination of North Korea's nuclear weapons programs. This must include getting clarity on North Korea's efforts to enrich uranium and its proliferation of nuclear technology abroad."<sup>98</sup>

Key concerns about the details of the tentative verification agreement as well as whether North Korea had actually agreed to the provisions surfaced soon after the announcement. For example, while State Department officials said that North Korea agreed to removal of samples from the

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<sup>95</sup> "Foreign Ministry's Spokesman on DPRK's Decision to Suspend Activities to Disable Nuclear Facilities," KCNA, August 27, 2008. [<http://www.kcna.co.jp/index-e.htm>]

<sup>96</sup> [<http://www.iaea.org/NewsCenter/PressReleases/2008/prn200813.html>]

<sup>97</sup> See October 11, 2008 State Department Press Statement <http://2001-2009.state.gov/r/pa/prs/ps/2008/oct/110924.htm> and Fact Sheet [<http://2001-2009.state.gov/r/pa/prs/ps/2008/oct/110924.htm>]

<sup>98</sup> Statement of Senator Barack Obama on the Agreement with North Korea, October 11, 2008.

country for analysis, North Korea statements in press reports contradicted this.<sup>99</sup> The Six Party were unable to reach agreement on a codified version of the verification measures in their December 2008 meeting. Negotiations continue on the verification protocol, as North Korea appears to reject inclusion of sampling provisions.

## Future Considerations

The DPRK committed in 2005 to abandoning “all nuclear weapons and existing nuclear programs” and to returning to the Non-Proliferation Treaty and IAEA safeguards at an early date.<sup>100</sup>

The next stage, after disablement, will be the decommissioning and dismantlement of the weapons production facilities. The terms for this work still need to be negotiated. This stage may include a return of IAEA monitoring of nuclear material stocks (including weapons-usable separated plutonium) and verification of actual weapons dismantlement. The question of dismantling North Korea's nuclear warheads has not yet been addressed directly, although the September 2005 joint statement commits North Korea to abandon all nuclear weapons. Critics have raised concerns about the lack of clear verification provisions for these steps and the omission of specific references to key issues such as fissile materials, warheads, the reported uranium enrichment program, the nuclear test site, and nuclear proliferation activities and history (such as nuclear transfers to Syria).

Some analysts have proposed that the United States should be ready to implement cooperative threat reduction (CTR)-style programs in North Korea, as were created for the former Soviet Union.<sup>101</sup> These might include the redirection of North Korean nuclear weapon scientists to peaceful work.<sup>102</sup> North Korean officials have said that they are interested in eventually reorienting the Yongbyon workforce to the peaceful use of nuclear energy.<sup>103</sup> This could include research, medical and industrial applications, and not necessarily a nuclear power program.

## Issues for Congress

### Funding

Congress will have a clear role in considering U.S. funding for the disablement and decommissioning of North Korea's nuclear facilities, as well as other inducements for cooperation as agreed in the Six Party talks. U.S. assistance to nuclear disablement activities at Yongbyon is funded through the State Department's Nonproliferation and Disarmament Fund

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<sup>99</sup> “SKorea to press for sampling at NKorean nuke plants,” Agence France Presse, November 14, 2008. [[http://news.yahoo.com/s/afp/20081113/wl\\_asia\\_afp/nkoreanuclearweaponsnkoreaus](http://news.yahoo.com/s/afp/20081113/wl_asia_afp/nkoreanuclearweaponsnkoreaus)]

<sup>100</sup> <http://2001-2009.state.gov/r/pa/prs/ps/2005/53490.htm>

<sup>101</sup> Joel Wit, Jon Wolfsthal, Choong-suk Oh, “The Six Party Talks and Beyond: Cooperative Threat Reduction in North Korea,” CSIS Press, December 2005. [http://www.csis.org/media/csis/pubs/051216\\_ctr.pdf](http://www.csis.org/media/csis/pubs/051216_ctr.pdf)

<sup>102</sup> David Albright, “Phased International Cooperation with North Korea's Civil Nuclear Programs,” *Institute for Science and International Security*, March 19, 2007. <http://www.isis-online.org/publications/dprk/CivilNuclearNK.pdf>

<sup>103</sup> “North Korea and Its Nuclear Program—A Reality Check,” A Report to Members of the Committee on Foreign Relations, United States Senate, October 2008, S. Prt. 110-50.

(NDF). The State Department is paying the North Korean government for the labor costs of disablement activities, and also paying for related equipment and fuel. Approximately \$20 million has been approved for this purpose to date. NDF funds may be used “notwithstanding any other provision of law” and therefore may be used to pay North Korea. DOE’s National Nuclear Security Administration (NNSA) has been contributing its personnel as technical advisors to the U.S. Six-Party delegation and as technical teams on the ground at Yongbyon overseeing disablement measures. NNSA has estimated it has spent approximately \$15 million in support of Phase Two (Yongbyon disablement) implementation.<sup>104</sup> Congress has also provided funding for energy assistance to North Korea under the Six Party Talks.

## Authority

Congress also plays a role in establishing legal authority for assistance to nuclear disablement and dismantlement in North Korea. Section 102 (b) (the “Glenn Amendment” *U.S.C. 2799aa-1*) of the Arms Export Control Act prohibits assistance to a non-nuclear weapon state under the NPT that has detonated a nuclear explosive device. Due to this restriction, DOE funds cannot be spent in North Korea without a waiver. Congress passed language in the FY2008 Supplemental Appropriations Act (P.L. 110-252) that would allow the President to waive the Glenn Amendment restrictions and that stipulates that funds may only be used for the purpose of eliminating North Korea’s WMD and missile-related programs.<sup>105</sup> If the President does exercise the Glenn Amendment waiver authority, then DOE “will be able to procure, ship to North Korea, and use equipment required to support the full range of disablement, dismantlement, verification, and material packaging and removal activities that Phase Three will likely entail.”<sup>106</sup> NNSA has estimated that this could cost over \$360 million in FY2009 if verification proceeds and North Korea agrees to the packaging and disposition of separated plutonium and spent fuel at Yongbyon.

Congress has also expressed its concern that the Department of Energy have enough funds available to support the disablement of North Korea’s nuclear weapons arsenal and production capability. In the FY2008 Consolidated Appropriations Act, the Committees on Appropriations provided DOE’s NNSA with funding discretion to provide up to \$10 million towards its activities in North Korea. It also directs the Department to submit a supplemental budget request if additional resources are required during FY2008.<sup>107</sup>

Beyond the Glenn amendment restrictions, Department of Defense funds must be specifically appropriated for use in North Korea. Section 8045 of the FY2008 Defense Appropriations Act says that “None of the funds appropriated or otherwise made available in this Act may be obligated or expended for assistance to the Democratic People’s Republic of Korea unless specifically appropriated for that purpose.” Section 8044 of the FY2009 Consolidated Security,

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<sup>104</sup> Statement of William H. Tobey, National Nuclear Security Administration, U.S. Department of Energy, to the Senate Committee on Armed Services, July 31, 2008.

<sup>105</sup> Similar language appeared in the Senate version of the FY2009 Duncan Hunter National Defense Authorization Act (P.L. 110-417), but was not included in the House version. The final act includes it under “legislative provisions not adopted” under Title XII, since the waiver authority was passed earlier in the FY2008 Supplemental. See joint explanatory note:  
<http://armedservices.house.gov/pdfs/fy09ndaa/FY09conf/FY2009NDAAJointExplanatoryStatement.pdf>.

<sup>106</sup> Tobey testimony, *ibid*.

<sup>107</sup> See p. 50 of <http://www.rules.house.gov/110/text/omni/jes/jesdivc.pdf>.

Disaster Assistance, and Continuing Appropriations Act, 2009 (P.L. 110-329) also contains this language. However, authorization was given for CTR funds to be used globally. The FY2008 Defense Authorization Act specifically encourages “activities relating to the denuclearization of the Democratic People’s Republic of Korea” as a potential new initiative for CTR work. Senator Richard Lugar has proposed that the CTR program be granted “notwithstanding authority”<sup>108</sup> for this work since the Defense Department’s experience in the former Soviet Union, expertise and resources could make it well-positioned to conduct threat reduction work in North Korea and elsewhere. Currently, the Department of Defense is not working on disablement efforts, but there may be a future role for DOD as the Six Party process progresses to dismantlement work.

## **Policy Guidance**

Congress may choose to influence the course of negotiations with North Korea through legislation that limits or places requirements on U.S. diplomatic actions. For example, the North Korean Counter-Terrorism and Non-Proliferation Act (H.R. 3650) introduced in the 110<sup>th</sup> Congress called for certification by the President that North Korea has met a range of nonproliferation and political benchmarks before the administration could lift any U.S. sanctions.<sup>109</sup> Congress could establish reporting requirements on progress, or condition appropriations or disbursement to North Korea upon verification measures.<sup>110</sup> Congress could also be involved in other aspects of potential changes in U.S. relations with Pyongyang, such as the monitoring of human rights issues, funding for further denuclearization steps including verification provisions, and establishment of normalized ties once nuclear dismantlement has been achieved. Congress also plays a role in setting sanctions policies, as in the bill “Security through Termination of Proliferation Act of 2009” (H.R. 485).

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<sup>108</sup> So that funds may be used “notwithstanding any other provision of law.” Senator Richard Lugar, Remarks to National Defense University, October 2, 2008. <http://lugar.senate.gov/record.cfm?id=304026&&>

<sup>109</sup> This bill was introduced and referred to the House Committee on Foreign Affairs. H.R. 3650, September 25, 2007.

<sup>110</sup> For example, see S.Res. 399.