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## **Weapons of Mass Destruction: Trade Between North Korea and Pakistan**

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# Weapons of Mass Destruction: Trade Between North Korea and Pakistan

## Summary

In October 2002, the United States confronted North Korea about its alleged clandestine uranium enrichment program. Soon after, the Agreed Framework collapsed, North Korea expelled international inspectors, and withdrew from the Nuclear Nonproliferation Treaty (NPT). U.S. intelligence officials claimed Pakistan was a key supplier of uranium enrichment technology to North Korea, and some media reports suggested that Pakistan had exchanged centrifuge enrichment technology for North Korean help in developing longer range missiles.

U.S. official statements leave little doubt that cooperation occurred, but there are significant details missing on the scope of cooperation and the role of Pakistan's government. North Korea and Pakistan both initially denied that nuclear technology was provided to North Korea; President Musharraf admitted, however, in 2006 that such technology had been transferred. This report describes the nature and evidence of the cooperation between North Korea and Pakistan in missiles and nuclear weapons, the impact of cooperation on their weapons of mass destruction (WMD) programs and on the international nonproliferation regime. It will be updated as events warrant.

The roots of cooperation are deep. North Korea and Pakistan have been engaged in conventional arms trade for over 30 years. In the 1980s, as North Korea began successfully exporting ballistic missiles and technology, Pakistan began producing highly enriched uranium (HEU) at the Khan Research Laboratory. Benazir Bhutto's 1993 visit to Pyongyang seems to have kicked off serious missile cooperation, but it is harder to pinpoint the genesis of Pakistan's nuclear cooperation with North Korea. By the time Pakistan probably needed to pay North Korea for its purchases of medium-range *No Dong* missiles in the mid-1990s (upon which its *Ghauri* missiles are based), Pakistan's cash reserves were low. Pakistan could offer North Korea a route to nuclear weapons using HEU that could circumvent the plutonium-focused 1994 Agreed Framework and be difficult to detect.

WMD trade between North Korea and Pakistan raises significant issues for congressional oversight. Are there sources of leverage over proliferators outside the nonproliferation regime? Do sanctions, interdiction, and intelligence as nonproliferation tools need to be strengthened? How is the threat of proliferation interpreted within the nexus of terrorism and WMD? Further, has counterterrorism cooperation taken precedence over nonproliferation cooperation? If so, are there approaches that would make both policies mutually supportive?

See also CRS Report RL33590, *North Korea's Nuclear Weapons Program*, by Larry A. Niksch, and CRS Report RS21391, *North Korea's Nuclear Weapons: Latest Developments?*, by Sharon Squassoni.

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# Weapons of Mass Destruction: Trade Between North Korea and Pakistan

## Introduction

More than 30 years ago, states agreed to control trade related to weapons of mass destruction (WMD) to complement the agreements comprising the nonproliferation regime. Supplier controls are not foolproof, but many observers believe that national and multilateral export controls can slow, deter, and make WMD acquisition more difficult or costly for the determined proliferator until political change makes the weapons irrelevant or no longer desirable.<sup>1</sup>

A recurrent problem in controlling technology transfers is that key states do not participate in the regimes. Although they are still targets of supply-side restrictions, some proliferating states now are able to reproduce WMD technologies and systems and sell them abroad without formal restraints on trade. North Korea, Pakistan, and India are three such examples in the case of nuclear weapons and missile technology.<sup>2</sup>

When export controls and interdiction fail, some U.S. laws impose penalties on countries, entities, or persons for proliferation activities. The provisions are varied and extend across the range of foreign assistance (aid, financing, government contracts, military sales).<sup>3</sup> Penalties for engaging in enrichment or reprocessing trade were strengthened by the 1976 and 1977 Symington and Glenn amendments to the Foreign Assistance Act (now Sections 101 and 102 of the Arms Export Control Act). Later penalties were added for nuclear detonations, and other provisions established penalties for individuals. Missile proliferation-related sanctions were established in the Missile Technology Control Act 1990, which added Chapter VII to the Arms Export Control Act and similar language at Section 11B of the Export Administration Act of 1979. In addition to legislated penalties, the U.S. government also imposes sanctions through executive orders.

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<sup>1</sup> Several countries have made political decisions to stop WMD programs, sometimes coinciding with regime changes, e.g., Argentina and Brazil halted their nuclear weapons programs and South Africa dismantled its nuclear weapons in the 1990s. The U.S. stopped its biological weapons program in advance of the Biological Weapons Convention and Libya renounced all its WMD programs in December 2003.

<sup>2</sup> China has only belatedly joined supplier restraint groups. A member of the Zangger Committee, China joined the NPT in 1992 and has agreed to adhere to MTCR guidelines. China also joined the Nuclear Suppliers Group in 2004.

<sup>3</sup> See CRS Report RL31502, *Nuclear, Biological, Chemical, and Missile Proliferation Sanctions: Selected Current Law*, by Dianne E. Rennack.

In October 2002, the Bush Administration announced that North Korea had been pursuing a clandestine uranium enrichment program; U.S. intelligence officials leaked to the press a few days later that Pakistan, among other countries, was implicated.<sup>4</sup> The outlines of a missiles-for-nuclear technology trade were reported in the press.<sup>5</sup> Pakistani government officials denied such trade. The State Department offered assurances that cooperation between the two was a thing of the past. In March 2003, the Bush Administration imposed sanctions on North Korean and Pakistani entities for cooperation in missiles.<sup>6</sup> In a letter to Congress, the State Department explained that “the facts relating to the possible transfer of nuclear technology from Pakistan to North Korea...do not warrant the imposition of sanctions under applicable U.S. laws.”

In late 2003, a convoluted turn of events involving nuclear safeguards inspections in Iran and a decision by Libya in December to renounce its WMD programs provided evidence that Pakistani scientists had supplied nuclear technology to Iran, Libya, and North Korea. Pakistani officials denied any government knowledge of such cooperation and at first, denied that A.Q. Khan (former head of Khan Research Laboratories) and his associates had assisted Libya or North Korea. Khan confessed to his proliferation misdeeds in early February 2004 and was pardoned by President Musharraf immediately. Interviewed on February 17, 2004, Musharraf noted that Pakistan’s investigation had not uncovered evidence of transfers to other countries other than Iran and Libya.”<sup>7</sup> It was not until President Musharraf published his memoirs in September 2006 that he admitted nuclear technology had been sold to North Korea.

Nonetheless, President Bush, in a speech that focused on proliferation at the National Defense University on February 11, 2004, stated that Khan and others sold “nuclear technologies and equipment to outlaw regimes stretching from North Africa to the Korean Peninsula.” Bush further stated that “Khan and his associates provided Iran and Libya and North Korea with designs for Pakistan’s older centrifuges, as well as designs for more advanced and efficient models.”<sup>8</sup>

Both North Korea and Pakistan have been subject to sanctions in the past for WMD trade. North Korea has been under one form or another of sanctions for close

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<sup>4</sup> “A Nuclear North Korea: Intelligence; U.S. Says Pakistan Gave Technology to North Korea,” *New York Times*, October 18, 2002.

<sup>5</sup> See “Pakistan’s Benazir Oversaw Korea Nuclear Deal - sources,” *Reuters News*, November 20, 2002.

<sup>6</sup> *Federal Register*, Vol. 68, No. 63, April 2, 2003, pp. 16113-16114. The U.S. imposed sanctions on Khan Research Laboratories (KRL) in 1993 for receipt of M-11 missiles from China; in 1998 for missile-related cooperation with Changgwang Sinyong Corporation and again in 2003.

<sup>7</sup> “Pakistan Rejects Nuclear Inspection,” *London Financial Times*, February 18, 2004.

<sup>8</sup> “President Announces New Measures to Counter the Threat of WMD,” Remarks by the President on Weapons of Mass Destruction Proliferation, Fort Lesley J. McNair, National Defense University, Washington, D.C.  
[<http://www.whitehouse.gov/news/releases/2004/02/20040211-4.html>]

to fifty years; Pakistan has been sanctioned in what some observers deem an “on again, off again” fashion, mostly for importing WMD technology, and also for testing a nuclear device.<sup>9</sup> The sanctions on the North Korean entity, Changgwang Sinyong Corporation, were imposed pursuant to the Arms Export Control Act and the Export Administration Act on the basis of knowing involvement in the transfer of Category I (under the Missile Technology Control Regime) missiles or components. The sanctions on the Pakistani entity, Khan Research Laboratories, were imposed pursuant to Executive Order 12938 from March 2003 to March 2005. Both of these entities have been sanctioned repeatedly in the past for missile trade. On the nuclear side, all sanctions were waived following September 11, 2001, and it is unlikely that such sanctions will be imposed again, absent significant evidence of the Pakistani government’s involvement in nuclear trade.

### **Rogue State Symbiosis?**

At first glance, North Korea and Pakistan do not seem the likeliest of proliferation bedfellows. However, they have traded in conventional armaments for over thirty years and forged a firm relationship during the Iran-Iraq War (1980-1988), during which both provided assistance to Iran. North Korea’s sale of Scuds and production capabilities proved particularly important to Iran.<sup>10</sup>

Neither state lies completely outside the nonproliferation regimes. Despite its extreme isolation, North Korea signed the Nuclear Nonproliferation Treaty (NPT) in 1985 under pressure from the Soviet Union, and is a party to the Biological Weapons Convention (BWC). However, North Korea never lived up to its NPT obligations and formally withdrew from the treaty, effective April 10, 2003.<sup>11</sup> Most observers believe North Korea has one or two nuclear weapons (or at least the plutonium for them) and may now be able to add six or eight weapons to its arsenal, given successful reprocessing of the spent fuel at Yongbyon. (North Korea told an unofficial U.S. delegation in January 2004 that it had completed reprocessing the fuel at the end of June 2003. The unofficial delegation, including former head of the Los Alamos National Laboratory Sig Hecker, was shown an empty spent fuel pond, but little else to prove North Korean claims).<sup>12</sup> On October 9, 2006, North Korea tested a nuclear device, which many experts believe did not achieve its desired yield, if it achieved a nuclear yield at all.

Most observers believe North Korea probably has biological weapons. North Korea does not participate in the Missile Technology Control Regime (MTCR), nor

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<sup>9</sup> See CRS Report RS20995, *India and Pakistan: U.S. Economic Sanctions*, by Dianne E. Rennack, for a discussion of sanctions on Pakistan.

<sup>10</sup> Unpublished paper by Joseph S. Bermudez, Jr., “DPRK-Pakistan Ghauri Missile Cooperation,” 1996.

<sup>11</sup> See CRS Report RL33590, *North Korea’s Nuclear Weapons Program*, by Larry Niksch. North Korea also tried to withdraw from the NPT in 1994, but suspended its withdrawal.

<sup>12</sup> See CRS Report RS21391, *North Korea’s Nuclear Weapons: Latest Developments*. (Updated periodically.)

is it a party to the Chemical Weapons Convention (CWC).<sup>13</sup> After successfully reverse-engineering Soviet-origin Scud missiles, North Korea became a leading exporter of ballistic missiles beginning in the 1980s. According to the Central Intelligence Agency (CIA), North Korea attaches high priority to exporting ballistic missiles, which is a major source of hard currency.<sup>14</sup>

Pakistan, on the other hand, has never been as isolated as North Korea. It has relied significantly on outside sources of technology for its weapons programs but has not been thought of as a major exporter of WMD-related items. It remains to be seen whether the Pakistani military and/or government was involved at all with Khan's nuclear deals. Pakistan has long rejected the NPT and tested nuclear weapons in 1998, but is a party to the BWC and the CWC. Nonetheless, the U.S. Department of Defense believes Pakistan has "the resources and capabilities to support a limited BW research and development effort," and likely has a chemical weapons capability.<sup>15</sup> Pakistan has sought technical assistance in its ballistic missile programs from North Korea and China for over a decade.

To some, proliferation by states that have newly acquired WMD is inevitable, resulting from diffusion of technology, insufficient political will to enforce controls, or demand fueled by perceived threats or the continuing prestige of WMD. In the past, however, technology transfers between countries outside of the control regimes seemed limited by the lack of technical skill and technology or hard currency. By the mid-1990s, however, North Korea had a proven track record in ballistic missiles, and Pakistan had demonstrated its uranium enrichment capabilities. Although Pakistan apparently was hampered by a lack of hard currency, it could provide North Korea with a route to nuclear weapons using highly enriched uranium (HEU). This route would not only circumvent North Korea's Agreed Framework with the United States, but would also be difficult to detect using satellite imagery.

## North Korean Enrichment

At the time the 1994 Agreed Framework with North Korea was negotiated, there was concern about, but scant evidence of, North Korean interest in uranium enrichment. Reports relating to North Korea's procurement of enrichment-related equipment date as far back as the mid-1980s, a time when North Korea was progressing rapidly in its plutonium production program. For example, in 1987, North Korea reportedly received a small annealing furnace from the West German company Leybold AG. Although they have many other uses, annealing furnaces can be used in production of centrifuge rotors for uranium enrichment. A five-year-long German intelligence investigation conducted from 1985 to 1990 concluded that Iraq, and possibly Iran and North Korea obtained uranium melting information from

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<sup>13</sup> See The International Institute for Strategic Studies, *North Korea's Weapons Programmes: A Net Assessment* (London, January 2004) for excellent descriptions of all North Korea's WMD programs.

<sup>14</sup> See [[http://www.cia.gov/cia/reports/721\\_reports/jan\\_jun2003.htm](http://www.cia.gov/cia/reports/721_reports/jan_jun2003.htm)].

<sup>15</sup> Department of Defense, *Proliferation: Threat and Response*, January 2001.

Pakistan in the late 1980s.<sup>16</sup> U.S. intelligence sources also believed that technicians employed by Leybold AG were involved in transferring equipment and information to North Korea. One or two such technicians were in North Korea in 1989 and another Leybold employee reportedly was seen there in 1990. Subsidiaries of Leybold AG were also involved in exporting centrifuge-related welding equipment to Iraq in the late 1980s.<sup>17</sup>

Negotiators of the Agreed Framework were aware that North Korea's NPT obligations did not prohibit uranium enrichment, and that the Agreed Framework did not directly address uranium enrichment.<sup>18</sup> North Korea was bound not to possess plutonium reprocessing or uranium enrichment facilities by virtue of the 1992 Joint Declaration of a Denuclearized Korean Peninsula — a bilateral agreement with South Korea that called for subsequent meetings. The U.S.-North Korean Agreed Framework required North Korea to make progress in implementing the joint declaration, but the process languished. Throughout the 1990s, the U.S. government continued to look for signs of enrichment and in 1998, the United States sent a team to Kumchang-ni to look for undeclared nuclear activities, including uranium enrichment. The team concluded that the site was not nuclear-related. By 1999, according to one former official, however, there were clear signs of active North Korean interest in uranium enrichment.

## Current Status

North Korea has continued to deny it has an enrichment program. Vice Minister Kim Gye Gwan told an unofficial U.S. delegation to Pyongyang in January 2004 that, "We do not have a highly enriched uranium program, and furthermore we never

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<sup>16</sup> "Agencies Trace Some Iraqi URENCO Know-How to Pakistan Re-Export," *Nucleonics Week*, November 28, 1991, pp. 1, 7-8.

<sup>17</sup> "Iraq's Bomb, Chip by Chip," *New York Times*, April 24, 1992.

<sup>18</sup> Ambassador Robert Gallucci, who negotiated the Agreed Framework, told a roundtable convened at the Center for Strategic and International Studies in 2003 that: "I would have to say that, yes, the Agreed Framework is less than perfect and there are vulnerabilities... The most glaring problem was that we were trying to stop the nuclear weapons program and we focused on the existing weapons program in North Korea based upon plutonium... But we did not achieve any additional transparency. We had no new inspection regime and all of us were keenly aware that one could build nuclear weapons not only with the existing facilities, but also with new, secret ones. I was asked in testimony in 1995, and many times privately by Senators and Congressmen, whether North Korea could cheat. I said, yes, they could and if they did it would probably be in the area of enrichment and the technology would be centrifuge. This was common sense. Many of us had been around the track with other countries that had done exactly this... Although we could predict it, why did we not do something about it? Because we did not think it was negotiable. That's a judgment of the negotiating team and the government at the time. It was not my personal judgment only. We made the best deal we could, and we reported that the way to deal with this vulnerability was to monitor North Korea just as carefully as we would if we did not have a deal, through our intelligence capabilities and the intelligence capabilities of our allies. We would try to catch them if they cheated, and the program we knew about we could monitor."



admitted to one.”<sup>19</sup> In addition, North Korea has not admitted that it has an enrichment program in the course of the six-party talks.

On February 24, 2004, CIA Director George Tenet told the Senate Select Committee on Intelligence that “We ...believe Pyongyang is pursuing a production-scale uranium enrichment program based on technology provided by AQ Khan, which would give North Korea an alternative route to nuclear weapons.” This estimate indicates either that North Korea has made progress since the CIA distributed a one-page, unclassified white paper to Congress on North Korean enrichment capabilities in November 2002, or that the CIA has new information on North Korean capabilities. The November 2002 paper noted that the United States had “been suspicious that North Korea has been working on uranium enrichment for several years,” and that it obtained clear evidence “recently” that North Korea had begun constructing a centrifuge facility.<sup>20</sup> The CIA concluded that North Korea began a centrifuge-based uranium enrichment program in 2000. Further, the paper noted that, in 2001, North Korea “began seeking centrifuge-related materials in large quantities. It also obtained equipment suitable for use in uranium feed and withdrawal systems.” The CIA “learned that the North 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.” In the Deputy Director of National Intelligence’s report, “Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions,” 1 January-31 December 2004 (pursuant to Section 721 of the of the FY1997 Intelligence Authorization Act), there is no mention of any North Korean uranium enrichment activity or capability. Few observers believe that North Korea now has an operating uranium enrichment plant.

Media reports suggested that the CIA had evidence of construction and of procurement. “Clear evidence” of construction of a centrifuge facility could mean photographs of construction sites, but the phrasing that the CIA “learned that the North has begun constructing a plant” is ambiguous enough to suggest the possibility that such information comes from a defector. According to former U.S. ambassador Donald Gregg, who became ambassador to South Korea in 1989 after retiring from the CIA, North Korea is “an extraordinarily difficult target to go after.”<sup>21</sup> The unclassified one-page paper distinguishes between North Korea seeking materials and actually obtaining equipment.

According to U.S. intelligence officials, the CIA does not know where North Korea is enriching uranium.<sup>22</sup> According to a State Department official, the Administration has narrowed possible uranium enrichment sites down to three. Outside observers have suggested that Yongjo-ri, Hagap, Taechon, Pyongyang, and

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<sup>19</sup> Testimony of Dr. Sigfried Hecker before the Senate Foreign Relations Committee, “Update on the North Korean Nuclear Issue,” January 21, 2004.

<sup>20</sup> Untitled working paper on North Korea’s nuclear weapons and uranium enrichment distributed by CIA to Congressional staff on November 19, 2002.

<sup>21</sup> “N. Korea Keeps U.S. Intelligence Guessing,” *USA Today*, March 11, 2003.

<sup>22</sup> *Ibid.*

Ch'onma-san might all be potential sites for enrichment. One defector, who was debriefed by Chinese officials in 1999 (he later returned to North Korea, where, it is assumed, he was killed), claimed that North Korea was operating a secret uranium processing site under Mt. Chun-Ma. Commercial satellite photos of Hagap show tunnel entrances but little else.

Detecting clandestine uranium enrichment is generally considered to be more difficult than detecting clandestine plutonium production for several reasons. First, satellite imagery is most useful when changes can be detected at known facilities, or in detecting new facilities. Reactors and reprocessing facilities used in plutonium production often have telltale signatures (shape, size, features like no windows in a reprocessing plant, connection to a water source, power plants or connection to an electricity grid, environmental releases), which facilitate remote detection. Uranium enrichment plants often do not, although this varies among the techniques used. For example, gaseous diffusion enrichment plants often are very large and require tremendous amounts of electricity, offering some distinguishable features. In contrast, centrifuge plants can be small, emit few environmental signatures, and do not require significant amounts of energy to operate.

## **Pakistani Assistance**

There is currently no detailed, unclassified information on the assistance Pakistan might have offered. One media report, citing Western officials, said the aid included a complete design package for a centrifuge rotor assembly, while a Japanese report stated that Pakistan had exported actual centrifuge rotors (2,000-3,000) to North Korea.<sup>23</sup> The *Washington Post* reported that North Korean efforts to procure high strength aluminum and significant construction activity tipped off the United States.<sup>24</sup> Apparently, North Korea attempted to obtain materials from China, Japan, Pakistan, Russia, and Europe, but Pakistan provided most of the assistance related to the rotors. A Pakistani official involved in Khan's investigation reportedly said North Korea ordered P-1 centrifuge components from 1997 to 2000.<sup>25</sup> The scope of Pakistan's cooperation with Libya and Iran (including P-1 and P-2 designs, a nuclear weapon design for Libya, and some complete rotor assemblies) raises significant questions about how much other help Khan might have given to the North Koreans. In his September 2006 memoir, Pakistani President Musharraf stated that he believes that Khan sent some of "Pakistan's most technologically advanced nuclear centrifuges."<sup>26</sup>

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<sup>23</sup> "CIA Assessment on DPRK Presumes Massive Outside Help on Centrifuges," *Nuclear Fuel*, Nov. 25, 2002.

<sup>24</sup> "U.S. Followed the Aluminum; Pyongyang's Effort to Buy Metal was Tip to Plans," *Washington Post*, Oct. 18, 2002.

<sup>25</sup> "Scientist Claimed Nuclear Equipment Was Old, Official Says," *Los Angeles Times*, Feb. 10, 2004.

<sup>26</sup> "In Book, Musharraf Expands on North Korean Nuclear Link," *Washington Post*, Sept. 26, 2006.

## Technical Implications

If North Korea may already have plutonium-based nuclear weapons, what is the technical significance of acquiring a uranium enrichment capability? On the one hand, acquiring fissile material is, to many observers, the most difficult part of nuclear weapons acquisition. On the other hand, North Korea's plutonium production program is no longer bound by the Agreed Framework. North Korea began operating its 5MW reactor and has claimed to have completed reprocessing the spent fuel in storage (although the U.S. has not confirmed this). North Korea therefore now may be able to augment its current stockpile of 1-2 weapons' worth of plutonium with additional plutonium for about 5 to 6 weapons.

Currently, most accounts suggest that North Korea does not have a completed enrichment plant. In order to produce enough HEU for 1 to 2 weapons (about 50kg), North Korea would require cascades of thousands of centrifuges. If North Korea has the capability to produce its own centrifuge rotors, or has completed assemblies already, producing HEU might be considered easier than its other fissile material production options. The unofficial U.S. delegation that visited North Korea in January reported that the larger reactor under construction at Yongbyon was clearly in disrepair. The unclassified CIA 2002 paper estimated that North Korea could produce enough weapons-grade uranium for two or more nuclear weapons per year when the enrichment plant is fully operational.<sup>27</sup> It is not clear how this estimate was arrived at, and whether evidence that Pakistan provided P-1 or even P-2 centrifuge technology was available at that time.<sup>28</sup>

Revelations that Libya received a nuclear weapons design from a foreign source raise concerns about whether North Korea also received such a nuclear weapons design.<sup>29</sup> According to media reports, the packet of information that Libya received on the nuclear weapon included Chinese text and step-by-step instructions for assembling a vintage-1960s HEU implosion device.<sup>30</sup> The Chinese markings are significant because of long-standing rumors that China provided Pakistan with a nuclear weapons design. For North Korea, receiving a proven design for an HEU

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<sup>27</sup> Untitled working paper on North Korea's nuclear weapons and uranium enrichment distributed by CIA to Congressional staff on November 19, 2002.

<sup>28</sup> The P-1 centrifuge design uses aluminum and is modified from a 1970s URENCO design, which AQ Khan reportedly stole. The Pakistani program apparently now uses a P-2 centrifuge design, which is a more advanced design, with greater efficiency, using maraging steel.

<sup>29</sup> The International Atomic Energy Agency's (IAEA) report, GOV/2004/12, "Implementation of the NPT Safeguards Agreement of the Socialist People's Libyan Arab Jamahiriya," February 20, 2004 states Libya received "documentation related to a nuclear weapon design and fabrication from a foreign source" p. 6.

<sup>30</sup> "Warhead Blueprints Link Libya Project to Pakistan Figure," *New York Times*, February 4, 2004; and "Libyan Arms Designs Traced Back to China," *Washington Post*, February 15, 2004. The implicit assumption is that Pakistan provided a nuclear weapon design it received from China in the 1980s to Libya.

implosion device would be a significant advantage for its nuclear weapons program.<sup>31</sup>

Quite possibly, the main benefit of a centrifuge enrichment program — the ability to produce fissile material clandestinely — may no longer be of great importance to North Korea since it left the NPT in 2003. Nonetheless, such a program may make the North Korean arsenal less vulnerable to possible military strikes because centrifuge enrichment facilities are hard to detect. In addition, the production of highly enriched uranium, together with plutonium production, could give the North Koreans the option of producing more sophisticated nuclear weapons, for example, using composite pits or boosted fission techniques (although there are no indications that they have the technical skill to do so).

## Pakistan's Missile Development

Pakistan, according to many observers, has two clearly distinct missile development programs. The first program is run by the Pakistan National Development Complex (PNDC) in collaboration with the Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) and the Pakistan Atomic Energy Commission (PAEC) and has focused since the early 1980s on solid-fueled ballistic missiles. Pakistan currently fields about 80 of the first variant, the *Hatf 1*. The *Hatf 1* is a short-range, solid propellant, unguided missile considered by some to be too small for a nuclear warhead, which was flight-tested in 1989 and fielded in 1992. The 80km-range was extended to 300km in the *Hatf 2a*, and to 800km in the *Hatf 3*. Despite claims of indigenous development, there are many indications that the *Hatf 1*, 2, and 3 benefitted from Chinese and European assistance. Some believe that Pakistan renamed some imported Chinese M-11 missiles as *Hatf 2a* missiles in the early 1990s; many believe that the *Hatf 3* are variants of Chinese M-9 missiles, and there are those who believe that the *Hatf 4* (*Shaheen 1*) may be based on Chinese M-11s. Pakistan tested its *Hatf 6* missile (*Shaheen 2*), which reportedly has a 2000-km range, in early March 2004 for the first time.

The second development program has been headed by Khan Research Laboratories. One report has suggested that these competing ballistic missile development efforts were aligned with competing nuclear warhead efforts — that is, the team developing a plutonium warhead for Pakistan's bomb, the PAEC, worked towards developing Chinese-derived nuclear-capable missiles, while the HEU team (KRL), collaborated with North Korea on liquid-fueled missiles derived from Scuds.<sup>32</sup> In any event, it is clear that KRL cooperated with North Korea in

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<sup>31</sup> There are some reports that North Korean scientists were present at Pakistan's 1998 nuclear tests and some speculation that Pakistan tested a North Korean plutonium device during those tests, but there is little public evidence to support this latter claim. See "Pakistan May Have Aided North Korea A-Test," *New York Times*, February 27, 2004.

<sup>32</sup> Simon Henderson, "Pakistan's Nuclear Proliferation and U.S. Policy," *Policy Watch*, The Washington Institute for Near East Policy, January 12, 2004.

developing the *Ghauri (Hatf 5)*, reportedly beginning around 1993.<sup>33</sup> The *Ghauri 1* is a liquid-propellant, nuclear-capable, 1500km-range ballistic missile, which was successfully flight-tested first in April 1998. Pakistan now fields approximately 5 to 10 of these missiles and is developing longer-range variants.

## North Korean Assistance

Pakistani ballistic missile engineers developed working relationships with North Korean engineers in the mid-1980s when they both assisted Iran during the Iran-Iraq war. In fact, the close resemblance of Iran's *Shahab* missile and the *Ghauri 1* has led many to conclude that the development of the missiles was coordinated between Pakistan, Iran, and North Korea around 1993.<sup>34</sup> In 1992, Pakistani officials visited North Korea to view a *No Dong* prototype, and again in 1993 for a *No Dong* flight test.<sup>35</sup> There are reports that then-Prime Minister Benazir Bhutto visited Pyongyang for one day in December 1993 and many analysts believe missile sales were on the agenda of her visit, despite her public denial.<sup>36</sup> According to one report, North Korea sent 5 to 12 *No Dong* missile assembly sets to Pakistan between 1994 and 1997; North Korea denies the allegation.<sup>37</sup> At the end of 1997, intelligence agencies observed regular flights from North Korea to Pakistan, accelerating in the beginning of 1998 when there were about 9 flights per month. These flights reportedly followed the visit of high-level North Korean officials to Pakistan.<sup>38</sup> A.Q. Khan apparently made 13 visits to North Korea, beginning in the 1990s.<sup>39</sup> Many observers believe Pakistan accepted between 12 and 25 complete *No Dong* missiles in the late 1990s.

Some observers believe that cooperation has gone both ways — that Pakistan assisted North Korea in developing solid propellant technology. The *Taepo Dong 1*, which was flight-tested in August 1998, reportedly had a third, solid-propellant stage. Both Iranian and Pakistani personnel apparently were present for the flight test in

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<sup>33</sup> Duncan Lennox, *Jane's Strategic Weapon Systems*, Issue Thirty-Six, January 2002, p. 125.

<sup>34</sup> *Ibid.*, p. 126

<sup>35</sup> See Joseph S. Bermudez, Jr., "A History of Ballistic Missile Development in the DPRK," Center for Nonproliferation Studies Occasional Paper No. 2, Monterey Institute of International Studies, 1999, pp. 23-24.

<sup>36</sup> Daniel A. Pinkston, "When Did WMD Deals between Pyongyang and Islamabad Begin?" [<http://cns.miis.edu/pubs/week/021028.htm>].

<sup>37</sup> Duncan Lennox, editor, *Jane's Strategic Weapon Systems*, Issue 36, January 2002, p. 125.

<sup>38</sup> "Pakistan's Missile 'Was a Nodong'," *Jane's Missile and Rockets*, Volume 2, Number 5, May 1998, pp. 1-2.

<sup>39</sup> Seymour Hersh, "The Cold Test: What the Administration Knew About Pakistan and the North Korean Nuclear Program," *New Yorker*, January 27, 2003. "So Far U.S. Skirting Sanctions Issue on Pakistan's Centrifuge Aid to DPRK," *Nuclear Fuel*, December 9, 2002, quotes a Western source that A.Q. Khan was in the DPRK when the two countries' representatives closed a deal to cooperate on ballistic missiles and uranium enrichment. "The Evil Behind the Axis?" *Los Angeles Times*, January 5, 2003, quotes U.S. officials that Khan initiated talks with the North Koreans in 1992 for *No Dong* missiles.

1998, and both Iran and Pakistan have expressed interest in space launch vehicles. North Korean missiles have overwhelmingly used liquid propellants. If Pakistan provided such cooperation, it likely would have come from PAEC and not KRL.

## Technical Implications

In missile development, some important milestones include extending range and payload, improving accuracy, and enhancing deployability (for example, through stable propellants and mobile launchers). The medium-range *Ghauri 1* missiles significantly increase Pakistan's ability to target India and improve Pakistan's ability to deploy nuclear warheads by increasing the payload. With a payload of 1200kg and a range of 1500km, the *Ghauri* well exceeds the MTCR standard for a Category I, or nuclear-weapons capable, missile (500kg/300km). By contrast, the *Hatf 1* missiles have a range and payload of 80km and 500kg. A.Q. Khan has stated that the *Ghauri* is Pakistan's only nuclear capable missile. The *Ghauri 2*, still in development, will have a range of between 1800 and 3000km. Both could reach major Indian cities with large payloads.

The *Ghauri* missiles, because they use liquid propellant, are not as easily deployed as the *Shaheen 1* and *2* missiles (*Hatf 4* and *6*). These solid-fueled, medium-range missiles apparently are based on Chinese M-11s. The *Shaheens* are easier to prepare, require fewer support vehicles and personnel, and are far more accurate than the *Ghauris*.<sup>40</sup> There have been unconfirmed reports that the *Ghauri* missiles will be shelved in favor of the *Shaheens*. On the other hand, the *Shaheen 1* has a range of just 600km, while the *Shaheen 2* has a range, reportedly, of 2000km.

North Korea adhered to a moratorium on flight-testing ballistic missiles from September 1999 to July 2006. On July 5, 2006, North Korea flight-tested seven missiles, including a *Taepo-Dong-2* that failed 42 seconds after launch. How North Korea's renewed testing will affect North Korean-Pakistani missile cooperation is unclear because the objectives of North Korean testing and future directions of the Pakistani program are not known. However, Pakistan probably would be interested in increasing the payload and improving the accuracy and mobility of its missiles, which could indicate more interest in Chinese than North Korean assistance.

## Pakistan's Nuclear Sales

The genesis of Pakistan's nuclear cooperation with North Korea is murky. There are a few reports in trade journals of equipment passing through Pakistan on the way to North Korea, but it is difficult to pinpoint when cooperation began. In 1986, Swiss officials seized equipment (autoclaves and desublimers) en route to Pakistan that is typically used in uranium enrichment. Special steel containers were also seized. One source reports that uranium enrichment information may have been

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<sup>40</sup> Duncan Lennox, editor, *Jane's Strategic Weapon Systems*, Issue 36, January 2002, p. 126.

diverted from the German partner in URENCO, Uranit GmbH, to Pakistan via Switzerland and then reexported to North Korea.<sup>41</sup>

Whether provided solely at the behest of Khan, or with the government's blessing, it is clear that nuclear cooperation accelerated in the 1990s. One report says that cooperation between Pakistan and North Korea expanded into the nuclear and missile areas in Benazir Bhutto's second term (1993 to 1996) to include exchanges of scientists and engineers.<sup>42</sup> If Khan piggybacked his nuclear deals onto missile cooperation, then he certainly would have had many more opportunities in the mid- and late-1990s than before. As noted earlier, a Pakistani official involved in Khan's investigation reportedly said North Korea ordered P-1 centrifuge components from 1997 to 2000.<sup>43</sup>

It is clear that the Pakistan government sought to reorganize some of its nuclear programs and structure following the May 1998 tests, reportedly because it was now a "declared" nuclear weapons state. Part of this restructuring apparently included issuing regulations for controlling nuclear exports. In June 2000, the Pakistani government published an advertisement announcing procedures for commercial exports of nuclear material. Prospective exporters would need a "no objection certificate" from the Pakistan Atomic Energy Commission, which would also have the authority to verify and inspect all prospective nuclear exports. According to an article in the Pakistan daily, *Dawn*:

The items listed in the advertisement can be in the form of metal alloys, chemical compounds, or other materials containing any of the following: 1. Natural, depleted, or enriched uranium; 2. Thorium, plutonium, or zirconium; 3. Heavy water, tritium, or beryllium; 4. Natural or artificial radioactive materials with more than 0.002 microcuries per gram; 5. Nuclear-grade graphite with a boron equivalent content of less than five parts per million and density greater than 1.5g/cubic centimeter.<sup>44</sup>

Many of those items would be useful in a nuclear weapons program. The advertisement also listed equipment "for production, use or application of nuclear energy and generation of electricity" including:

- Nuclear power and research reactors
- Reactor pressure vessels and reactor fuel charging and discharging machines
- Primary coolant pumps
- Reactor control systems and items attached to the reactor vessels to control core power levels or the primary coolant inventory of the reactor core

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<sup>41</sup> "Agencies Trace Iraqi Urenco Know-how to Pakistan Re-Export," *Nucleonics Week*, November 28, 1991.

<sup>42</sup> B. Raman, "The Pakistan-North Korea Nexus," [http://www.rediff.com], March 10, 2004.

<sup>43</sup> "Scientist Claimed Nuclear Equipment Was Old, Official Says," *Los Angeles Times*, February 10, 2004.

<sup>44</sup> "Government Regulates Export of Nuclear Materials," *Dawn*, July 24, 2000.

- Neutron flux measuring equipment
- Welding machines for end caps for fuel element fabrication
- *Gas centrifuges and magnet baffles for the separation of uranium isotopes* (emphasis added)
- UF6 mass spectrometers and frequency changers
- Exchange towers, neutron generator systems, and industrial gamma irradiators

These guidelines, which implied that fissile material could be exported, apparently conflicted with earlier regulations. Several days later, Pakistan's Ministry of Commerce retracted the notice, saying that procedures were still under consideration.<sup>45</sup> The U.S. State Department reportedly responded by suggesting that the regulations did not authorize such exports, but seemed to be drawn from international control lists. U.S. and Pakistani officials apparently have been discussing export control measures since at least 2000. A key feature of Pakistan's regulations, however, is the explicit exemption of Ministry of Defense agencies from controls, which suggests that weapons programs under military leadership could skirt domestic export control laws.<sup>46</sup>

## U.S. Government Responses

U.S. officials reportedly raised with Islamabad suspicions of nuclear technology transfers between Pakistan and North Korea in 2000, prompting an investigation that revealed that KRL scientists had large deposits of money in their personal bank accounts. Pakistani officials reportedly informed the United States that the cooperation was conducted by individuals.<sup>47</sup> In March 2001, reportedly at U.S. insistence, A.Q. Khan was removed from his position as head of KRL, but retained the post of presidential adviser until early 2004. Shortly after Khan's dismissal, Deputy Secretary of State Armitage was quoted by the *Financial Times* as saying that "people who were employed by the nuclear agency and have retired" could be spreading nuclear technology to other states, including North Korea.<sup>48</sup> A senior U.S. nonproliferation official explained weeks later that Armitage's statement led to confusion about the cooperation; that it was really limited to missile cooperation.<sup>49</sup>

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<sup>45</sup> "Pakistan Clarifies Nuclear Export Control Guidelines, *Arms Control Today*, September 2000.

<sup>46</sup> Srivastava, Anupam and Gahlaut, Seema, "Curbing Proliferation from Emerging Suppliers: Export Controls in India and Pakistan," *Arms Control Today*, September 2003.

<sup>47</sup> "Pakistan Informed US of 'Personal' Nuclear Technology Transfer: Report" December 25, 2002, *Agence France-Presse*.

<sup>48</sup> "US Fears North Korea Could Gain Nuclear Capability through Pakistan," *Financial Times*, June 1, 2001.

<sup>49</sup> "North Korea Got a Little Help from Neighbors — Secret Nuclear Program Tapped Russian Suppliers and Pakistani Know-How," *Wall Street Journal Europe*, October 21, 2002; "North Korean-Pakistan Collusion Said Limited to KRL and Missiles," *Nuclear Fuel*, June 25, 2001.



Initially after the allegations of October 2002, Pakistani officials denied any involvement with North Korea's nuclear program. Pakistan's ambassador to the United States, Ashraf Jehangir Qazi, told the *Washington Post* that "No material, no technology ever has been exported to North Korea," adding that while "Pakistan has engaged in trade with North Korea, nobody can tell us if there is evidence, no one is challenging our word. There is no smoking gun."<sup>50</sup> Nonetheless, Secretary of State Powell told ABC's *This Week* that "President Musharraf gave me his assurance, as he has previously, that Pakistan is not doing anything of that nature...The past is that past. I am more concerned about what is going on now. We have a new relationship with Pakistan."<sup>51</sup> Powell stressed that he has put President Musharraf on notice: "In my conversations with President Musharraf, I have made clear to him that any, any sort of contact between Pakistan and North Korea we believe would be improper, inappropriate, and would have consequences."<sup>52</sup>

Khan's confession in 2004 raises an important question of whether the Pakistani government knew of, aided, or abetted his nuclear assistance to North Korea. Khan has alleged that military officials knew of the transfers, but few details have emerged. One account states that Generals Musharraf, Karamat and Waheed knew of aid to North Korea when they were chiefs of the Army staff.<sup>53</sup> Pakistani officials have consistently averred that any nuclear technology was transferred on a personal basis, without the acquiescence or knowledge of the Pakistani government.<sup>54</sup> This could explain why the Bush Administration thus far, has not sought sanctions against Pakistan. In a letter to key senators and members of Congress on March 12, 2003, Assistant Secretary of State for Legislative Affairs Paul Kelly wrote that "the Administration carefully reviewed the facts relating to the possible transfer of nuclear technology from Pakistan to North Korea, and decided that they do not warrant the imposition of sanctions under applicable U.S. laws." However, President Musharraf revealed in his 2006 memoir that he suspected Khan was cooperating with North Koreans as early as 1999, when he received a report that "some North Korean nuclear experts, under the guise of missile engineers, had arrived... and were being given secret briefings."<sup>55</sup>

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<sup>50</sup> "Pakistan's N. Korea Deals Stir Scrutiny; Aid to Nuclear Arms Bid May Be Recent," *Washington Post*, November 13, 2002.

<sup>51</sup> Reported in "North Korea Got a Little Help from Neighbors — Secret Nuclear Program Tapped Russian Suppliers and Pakistani Know-How," *Wall Street Journal Europe*, October 21, 2002. Transcript of ABC *This Week* from October 20, 2002.

<sup>52</sup> *Wall Street Journal*, December 2, 2002.

<sup>53</sup> "Musharraf Named In Nuclear Probe," *Washington Post*, February 3, 2004.

<sup>54</sup> "Pakistan informed US of 'personal' nuclear technology transfer," *Agence France-Presse*, December 25, 2002 (based on report from *Jiji Press* news agency). According to this and other reports, the apparent tip-off was tens of thousands of dollars deposited into the personal bank accounts of Pakistani scientists at Kahuta (Khan Research Laboratories).

<sup>55</sup> "In Book, Musharraf Expands on North Korean Nuclear Link," *Washington Post*, Sept. 26, 2006.

Apparently President Musharraf sought to dampen rumors that Pakistan traded nuclear secrets for missile help by stating that “whatever we bought from North Korea is with money.”<sup>56</sup> Evidence of such a barter would clearly implicate the Pakistani military and government, which could complicate U.S. decisions on aid to Pakistan and possibly trigger U.S. sanctions.

One analyst has suggested that Pakistan’s foreign currency reserve crisis in 1996 might have made a barter arrangement attractive.<sup>57</sup> In that year, the government was able to avoid defaulting on external debt with help from the International Monetary Fund and borrowed \$500M from domestic banks.<sup>58</sup> The reserves at that time were \$773 million, the equivalent of about three weeks of imports.<sup>59</sup> The next year, visits of North Korean and Pakistani officials accelerated, although this could be attributed solely to missile cooperation.

## Issues for Congress

North Korea’s actions alone raise significant policy questions for Congress, specifically, on how to roll back a capability that North Korea refuses to admit it has. However, WMD trade between two proliferators raises a host of other issues that may be pertinent to Congress’ oversight of nonproliferation programs and strategy and counterterrorism. First, leverage is needed from outside the traditional nonproliferation framework, since neither North Korea nor Pakistan is a member of the missile or nuclear control regimes. China is an obvious source of leverage because of its longstanding diplomatic, military, and economic ties to both countries, but the development of a new relationship between the United States and Pakistan based on counterterrorism cooperation may also be a source of leverage.

Second, this example of secondary proliferation highlights the critical roles of sanctions, interdiction, and intelligence. Nonproliferation sanctions appear to have had little effect on North Korea and Pakistan, while comprehensive sanctions against Libya, over thirty years, appear to have helped Libya decide to renounce its WMD.<sup>60</sup> Although intelligence information was used to help alert Pakistani officials to Khan’s technology trade, interdiction appeared to play a secondary role. It is not yet clear whether Khan’s forced retirement in 2001 cut off trade (in which case intelligence would have played a leading role) or whether it continued beyond that, until inspections in Iraq and Libya’s confessions made Khan’s position untenable.

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<sup>56</sup> “Pakistan Rejects Nuclear Inspection,” *London Financial Times*, February 18, 2004.

<sup>57</sup> Daniel A. Pinkston, “When Did WMD Deals between Pyongyang and Islamabad Begin?” [<http://cns.miis.edu/pubs/week/021028.htm>].

<sup>58</sup> “Emerging Market ADRs -2: Pakistan Currency Reserves Low,” *Dow Jones News Service*, February 4, 1997.

<sup>59</sup> Currently they stand at about \$10 billion.

<sup>60</sup> Martin Indyk, “The Iraq War Did Not Force Gadaffi’s Hand,” *London Financial Times*, March 9, 2004. Indyk reveals that Libya approached the United States in 1999 to discuss eliminating its WMD.

Further, intelligence information has not been able to locate uranium enrichment facilities in North Korea. Congress may wish to explore, in the context of the President's nonproliferation initiatives outlined on February 11, 2004, how to improve these capabilities.

The example of WMD trade between North Korea and Pakistan raises particular questions about how to interpret proliferation threats within the nexus of terrorism and WMD. Do these developments compromise the security of the United States and its allies because Pakistan and North Korea are developing new capabilities, or because sales of sensitive technologies continue unabated and could expand to terrorists? Since September 2001, the nexus of proliferation of WMD and terrorism has been called one of the greatest threats to U.S. security. Although North Korea is one of the seven state sponsors of terrorism, some in the administration believe that the nexus of terrorism and WMD is not as pronounced in North Korea as it has been elsewhere, for example, in Iraq.<sup>61</sup> Others believe, however, that there is a danger of North Korea proliferating its nuclear technology. Pakistan, while not a state sponsor of terrorism, clearly has terrorist activities on its soil, and potential terrorist access to its nuclear weapons has been a particular concern since September 11, 2001. At that time, nonproliferation concerns about Pakistan centered on the security of the Pakistani nuclear arsenal from terrorists and the activities of Pakistani nuclear scientists providing assistance to terrorists or other states. The inadvertent leakage of nuclear know-how appeared to be a serious threat. Although the Pakistani government repeatedly has assured the world that its nuclear program is safe, there are those who believe this may not be true. In the case of trade with North Korea, it is unclear whether alleged nuclear transfers occurred with the blessing of the Pakistani government or on the personal initiative of scientists. Some have maintained that Pakistan should be able to provide evidence that it provided cash — rather than nuclear technology — in return for North Korean missiles and components that apparently were loaded onto government-owned C-130 aircraft. Others maintain the United States should press harder for direct access to Khan to learn the scope of his activities.

A broader question is whether the Bush Administration has given higher priority, since September 2001, to cooperation on counterterrorism than to cooperation in nonproliferation. For example, when North Korea shipped Scud missiles to Yemen in December 2002, North Korea was sanctioned while Yemen was not sanctioned for receiving them; Yemen has been actively cooperating with the United States in counterterrorism activities.<sup>62</sup> When asked if the countries that provided assistance to North Korea on the enrichment program would risk being cut off from U.S. assistance, White House spokesman Ari Fleischer responded:

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<sup>61</sup> Remarks by Deputy Secretary of State Armitage to Senate Foreign Relations Committee Hearing on North Korea, February 4, 2003.

<sup>62</sup> When asked at the daily press briefing on December 11, 2002 about waiving sanctions against Yemen for its receipt of Scuds from North Korea, State Department Richard Boucher said, "We decided to waive it because of the commitments that they [Yemen] had made and in consideration of their support for the war on terrorism." He later elaborated that "We have done a lot of cooperation, training, exchange of information, law enforcement cooperation with the Government of Yemen and we want to continue to do that."

Well, yes, since September 11th, many things that people may have done years before September 11th or some time before September 11th, have changed. September 11th changed the world and it changed many nations' behaviors along with it. And don't read that to be any type of acknowledgment of what may or may not be true. But September 11th did change the world.<sup>63</sup>

Fleischer's statement appears to imply that forgiveness of proliferation that occurred before September 11, 2001 is in order because counterterrorism takes precedence over counterproliferation. Combating terrorism and weapons of mass destruction, however, are both important objectives for the United States and Congress may consider, in its oversight role, how we can successfully balance both. Pakistan is clearly a key ally in the global war on terror, but the considerable uncertainty about the Pakistani government's involvement in Khan's activities, particularly with respect to North Korea, raises questions about its past, but also future, cooperation in combating the spread of weapons of mass destruction.

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<sup>63</sup> Transcript, White House press briefing, October 18, 2002.