**Containing Missile Proliferation**

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Author's update

This update in April 2009 replaces earlier updates, and covers missile developments after this book was originally published (see http://homepages.uc.edu/~mistrydj/ContainingMissileProliferation for further updates).

## Chapter 4. Argentina, Brazil, South Africa

*Argentina*

In 2008, Argentina announced plans to build a Tronador-3 satellite launcher by 2012.[1] This 30 ton liquid-fuel rocket was designed to place a 200 kg satellite in an orbit of 500 kilometers. Argentina tested a very light 60 kg Tronador-1 rocket in 2007 and 2008, and planned to build a 600 kg Tronador-2 by 2010. Still, Tronador-1 and -2 are very low capability sounding rockets. Argentina would have to develop entirely new more powerful engines and new technologies for the Tronador-3, which would be an order of magnitude more powerful than the Tronador-2, and would be as powerful as a medium-range missile.

*Brazil*

Brazil failed for the third time in three attempts to place a satellite in orbit when, in September 2003, its VLS rocket exploded on the launch pad two days before a planned flight. In October 2008, it tested the VLS second stage (a 5.6 ton S-40TM motor), and it planned to again launch the VLS in 2011. Brazil also developed a small 2.6 ton VSB-30 suborbital rocket, using the Sonda-3's 1.2 ton S-30 motor for its first stage and a new 0.9 ton S-31 motor for its second stage. This rocket first flew in October 2004, and was subsequently launched in December 2005, May 2006, and July 2007.

[1] "Within four years the country will have its own satellite launcher," *La Nacion*, October 20, 2008.

## Chapter 5. South Korea, Taiwan, Arab States

*Taiwan*

Taiwan developed a land-attack cruise missile, the 600 km range Hsiung Feng 2E, testing it in early 2005 and again in 2006 and 2007. Taiwan's military then planned to build 245 such missiles over eight years, but its parliament cut the missile's budget (and then restored it in 2008), delaying the missile's production.

*South Korea*

South Korea announced the development of a 500 km range Chonyrong cruise missile in September 2006. In October 2006, press reports noted that South Korea's Agency for Defense Development (ADD) had tested a 1,000 km range Hyonmu-3 cruise missile.[2]

South Korea also advanced its space program. In 2002, it launched a 6 ton liquid-fuel KSR-3 sounding rocket (South Korea's earlier KSR-1 and KSR-2 rockets used solid fuel). Thereafter, it collaborated with Russia to develop the KSLV space launcher, whose first flight was planned for 2009-2010. The KSLV had an approximately 140 ton liquid-fuel Russian Angara rocket as its first stage, and a small solid-fuel South Korean rocket as its second stage. It was designed to lift a 100 kg satellite to an orbit of 300 km.

*Missile Restraints in Iraq*

Iraq had been limited to 150 km range missiles after the 1991 Gulf War, and it worked on several such missiles in the 1990s.[3] One was the 1.2 ton solid-fuel al-Fatah, previously called Ababil-100, which had a 0.5 m diameter. It flew beyond 150 km in eight of its thirty-two flight tests

[2] Daniel Pinkston, "South Korea Tests 1000 km range Cruise Missile," *WMD Insights*, November 2006.

[3] Charles Duelfer, *Comprehensive Report of the Special advisor to the DCI on Iraq's WMD*, September 30, 2004.

(between September 2000 and October 2002) and reached 161 km in one test. Unable to develop a guidance system for this missile, Iraq deployed an unguided version with its army in late 2001. In total, Iraq built 100 to 120 of these missiles—60 were consumed in development and testing; 12 to 16 were fired on coalition forces; and 10 were recovered after the war.

Another Iraqi missile, the 1.8 ton liquid-fuel al-Samoud (initially also called Ababil-100), had a 0.5 m diameter. It reportedly reached 150 km in three of its forty-six flight tests (between October 1997 and September 2001). The small diameter design was unstable, and Iraq therefore discontinued the missile and developed an al-Samoud-2 with a 0.76 m diameter. This missile used an SA-2 engine (Iraq imported 380 such engines from entities in Poland and Russia in 2001-2) and components from the HY-2 cruise missile (which had a 0.76 m diameter). The missile flew beyond 150 km in thirteen of its twenty-six tests (between August 2001 and November 2002), reaching 183 km in one test. Iraq built some 130 of these missiles, of which 22 to 27 were used in flight tests; UN inspectors destroyed 72 in March 2003; 5 were fired against coalition forces; 15 were damaged or captured in the war; and the remainder are unaccounted for. During the March 2003 war, Patriot missile defense interceptors reportedly hit nine of Iraq's ballistic missiles. Missile defenses did not intercept or engage five HY-2 Seersucker cruise missiles and two unmanned air vehicles.

Beyond its al-Samoud programs, Iraq sought to buy the 280 km range SS-26 Iskander missiles from Russia in 2002. Further, in discussions with North Korea between 1999-2002, Baghdad sought technology for 1,300 km range Nodong-type ballistic missiles and anti-ship cruise missiles (presumably the 100-200 km range KN-01 missiles). In late 2001, it signed contracts worth $9 million with (and made a payment of $1.3 million to) North Korean firms for missile components such as guidance and control systems and test stands. Iraq did not receive North Korean technology or missiles by the time UN inspections resumed in October 2002.

*Missile Restraints in Libya*

Libya declared, in December 2003, that it would eliminate its weapons of mass destruction programs and limit itself to 300 km range missiles. Libya also revealed a North Korean-assisted production line for 600 km range Scud-Cs, and it shipped five Scud-Cs to the United States in March 2004. In September 2004, in an understanding with the US and UK, Libya agreed to eliminate its Scud-Bs by September 2009. Libya considered various options for destroying and replacing these missiles. One source noted an offer for Libya to sell its 417 Scud-Bs to the United States for $2 million each.[4] Another report noted that, in 2004-05, Washington initially opposed, but then acquiesced to, Libya's interest in purchasing Iskander missiles from Russia (as of 2009, however, Libya had not acquired Iskander missiles).

*Syria*

Syria tested one Scud-B and two Scud-Ds in May 2005, which were its first missile tests since 2001. Israeli missile defense radars detected additional Scud-D tests in January 2007 and in early 2008, when Syria also tested the SS-21. In additional missile activity, in 2005, Syria was considering buying, but was denied, 18 Russian Iskander ballistic missiles.[5] Other reports noted that Syria sought to transfer 30 Scud missiles to Sudan in and since January 2004, but these transfers may not have taken place. Finally, in 2007, two possible missile technology transfers to Syria were blocked by other states.

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[4] "Israel: US Rejects Demand to Buy Libya's 417 Scuds at $2 Million Apiece," *Yediot Aharoton*, February 1, 2005.

[5] "Like a Pogrom from the Blue: Russian Missiles Chill Russian-Israeli Relations," *Kommersant*, January 12, 2005.

## Chapter 6. Israel, India, Pakistan

*Israel*

Israel's sixth launch of its Shavit rocket failed in September 2004, resulting in the loss of its Ofeq-6 satellite. In June 2007, Israel's seventh Shavit launch successfully placed its Ofeq-7 satellite in orbit. In January 2008, Israel tested a ballistic missile that may have been a new Jericho-3 with a range longer than that of the Jericho-2.[6]

*Missile Advances in Pakistan*

Pakistan tested five ballistic missiles (Hatf-2 to Hatf-6) five to eight times each, and also tested two cruise missiles (Hatf-7 and Hatf-8).

Pakistan conducted the first to fifth tests of its 180 km range Abdali/Hatf-2 in May 2002, March 2003, March 2005, February 2006, and March 2007. It conducted the first to fifth tests of its 300 km range Ghaznavi/Hatf-3 in May 2002, October 2003, November 2004, December 2006, and February 2008. It tested its 700 km range Shaheen-1/Hatf-4 at least eight times—in April 1999, October 2002 (two tests), October 2003 (two tests), December 2004, November 2006, and January 2008. It launched the 1,000-1,500 km range Ghauri/Hatf-5 at least eight times—in April 1998, April 1999, May 2002, May 2004, June 2004, October 2004, November 2006, and February 2008. It tested the two-stage 2,500 km range Shaheen-2/Hatf-6 at least six times—in March 2004, March 2005, April 2006, May 2006, February 2007, and April 2008.

In addition, Pakistan tested its land-based cruise missile (the Babar or Hatf-7) in August 2005, March 2006, March 2007, July 2007 (from submarine torpedo tubes), and December 2007. The missile had a 500 km range, though an extended 700 km range version was tested in 2007. It may be derived from China's DH-10, which resembles the U.S. Tomahawk.[7] Further, Pakistan tested a 350 km range air-launched cruise missile (Raad or Hatf-8) in September 2007 and May 2008.

*Missile Advances in India*

India extensively tested short-range Brahmos cruise missiles and Prithvi ballistic missiles and conducted fewer tests of its Agni-1 and Agni-2 missiles, all of which were deployed with its armed forces. India's army fielded missile group 334 with the Agni-1, 335 with the Agni-2, and new groups 444 and 555 in addition to existing groups 222 and 333 with Prithvi missiles. India also tested new intermediate-range Agni-3 and submarine-launched K-15 missiles.

India conducted the twenty-first to twenty-eighth tests of its 150-250 km range Prithvi-1 and Prithvi-2 missiles in March and April 2003, January and March 2004, May 2005, June 2006, November 2006, and May 2008 (when the missile was taken from a routine production lot). It conducted the third to sixth tests of its 300-350 km range naval Prithvi-3 or Dhanush in October 2004, November 2004, December 2005, and March 2007. Press reports noted that in 2006-07, India's Bharat Dynamics Limited had produced 15 Prithvis and four training missiles that year; that the Indian navy was weaponizing two Sukanya-class patrol vessels with the Dhanush; and the Indian air force was moving some Prithvi missiles from south India to bases closer to the western front.[8]

Indian defense scientists also modified the Prithvi into a missile defense interceptor. They tested this Prithvi Air Defense (PAD) interceptor against a Prithvi missile target in November 2006, and against a ship-launched Dhanush missile target in March 2009; in December 2007, a different interceptor was fired against a Prithvi missile target.

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[6] "Missile test -Launched from Palmachim, heard in Tehran," *Haaretz*, January 18, 2008.

[7] Robert Hewson, "Chinese Air-launched Cruise Missile Emerges From Shadows," *Jane's Defence Weekly*, January 31, 2007.

[8] "India Steps up Production of Brahmos and Prithvi," *Times of India*, November 12, 2007.

India tested its 290 km range Brahmos cruise missile at least 19 times from 2001 to early 2009. These included tests in June 2001, April 2002 (in an inclined mode), February 2003 (from the naval vessel INS Rajput), October 2003, November 2003 (two tests, one from INS Rajput), June 2004, November 2004 (from INS Rajput), December 2004, April 2005 (from INS Rajput), November 2005, June 2006, February 2007, April 2007, March 2008 (the first test from a ship towards a target on land), and December 2008 (the first test from a vertical launcher on a moving warship, enabling the missile to hit targets anywhere in the 360-degree radius of the ship). In addition, the supersonic Brahmos Mark 2 was tested January 2009 (when the missile went off-course), and again on March 4 and March 29, 2009—India's army chief and deputy chief witnessed these tests at the Pokhran desert range.[9]

The Brahmos weighs 3.9 tons with its canister (or 3 tons without the canister) and carries a 300 kg payload. As noted above, its first two launches took place from land. The Indian navy then sought a ship-launched version, which was tested from the naval vessel INS Rajput. After four successful ship launches, Indian defense scientists worked on a mobile truck-launched version for the Indian army.[10] Two of the first four test launches for the army took place at Pokhran in Rajasthan. By early 2009, the Indian army had ordered two Brahmos regiments with 134 missiles, 10 road-mobile truck launchers, and four mobile command posts, which were expected to cost Rs. 8,000 crore ($1.6 billion), or Rs. 27 crore ($5 million) per missile. The navy had ordered 49 Brahmos firing units, including both anti-ship and land-attack versions.[11] Beyond production for the army and navy, Indian scientists were working on submarine-launched and air-launched versions of the Brahmos.[12]

India's Agni missiles were tested less frequently than the Brahmos and Prithvi. The 700 km range Agni-1 was tested five times from 2002 to 2008—in January 2002, January 2003, July 2004, October 2007, and March 2008 (this was a limited stock production test where the missile was selected at random from a lot of missiles). The 2,000 km range Agni-2 was tested three times—in April 1999, January 2001, and August 2004. The single-stage Agni-1 weighs 12 tons, including a 1 ton payload; the two-stage Agni-2 has the Agni-1's 10.8 ton first stage and a 4.2 ton second stage.

The Agni-3 was tested three times—in July 2006 (unsuccessfully), April 2007, and May 2008. This two-stage missile can reportedly carry a 1.5 ton payload to a range of 3,500 km. It weighs approximately 48 tons, with a 31-34 ton first stage and a 10-12 ton second stage. Indian defense scientists planned to upgrade the Agni-3 in two ways. First, they would add a third stage to increase its range to 5,000 km—this three-stage missile would be called Agni-5. They developed a motor casing made of carbon filament-wound composite for the third stage, and planned to use composites on at least two stages of the Agni-5.[13] The Agni-5 would be canister-launched and road-mobile (the Agni-2 was rail-mobile, and the Agni-3 was initially rail-mobile though Indian defense scientists also sought a road-mobile version). Second, Indian defense scientists intend to develop a submarine-launched version of the Agni-3.

[9] "Missile Man pierces army apathy: How a tenacious technocrat put the supersonic BrahMos back on track," *The Telegraph*, April 4 , 2009.

[10] "Cruising Along," *Frontline*, Vol. 24, Issue 13, June 30-July 13, 2007.

[11] "Brahmos missile test fails after early success," *Times of India*, January 21, 2009.

[12] "India steps up production of Prithvi and Brahmos," *Times of India*, November 12, 2007.

[13] "Full of Fire," *Frontline*, Vol. 25, Issue 11, May 24-June 6, 2008; "Agni-V design completed; to be test-fired in 2010," *The Hindu*, November 27, 2008.

In February 2008, India tested a different submarine-launched missile, the K-15. This 7 ton missile had a range of 700 km with a 500 kg payload. In November 2008, India fired the Shourya missile, that was believed to be the land-based version of the K-15.

## Chapter 7. North Korea and Iran

*Missile Advances in Iran*

Iran undertook four projects with missiles having ranges of approximately 2,000 km. It continued testing and extended the range of its Shehab-3 missile; possibly acquired a new Shehab-3B missile with a greater range; built a new solid-fuel missile; and built a satellite-launching rocket from its missiles.

First, Iran conducted the sixth and seventh tests of its 1,300 km range Shehab-3 missile in July 2003 and August 2004. The missile featured an advanced nose cone in August 2004. Later, Tehran declared that it had increased the missile's range to 2,000 km. Tehran again tested the Shehab-3 in January 2006, May 2006, and July 2008 (when it tested several other missiles).

Second, Tehran may have acquired a new Shehab-3B. Some reports note that Iran's January 2006 test involved this Shehab-3B or North Korean Nodong-B missile. North Korea reportedly developed the 2,500-3,000 km range Nodong-B based on the Russian SS-N-6/R-27 submarine launched missiles. U.S. officials noted that Tehran acquired 18 such missiles (or components of these missiles) from North Korea in 2006.[14]

[14] "US Estimates Iran Will Be Able to Strike US by 2015," *Jane's Defence Weekly*, May 16, 2007.

Third, Iran built a 2,000 km range two-stage solid-fuel Sajjil missile. In May 2005, Tehran announced that it tested a solid-fuel engine for a missile having a range greater than 2,000 km. In September 2007, Tehran displayed a Ghadr missile at a military parade and announced that it had a range of 1,800 kilometers. In November 2007, Iran's defense minister reported the development of a solid-fuel Ashura missile. In November 2008, Iran launched a two-stage solid-fuel missile with a range of 2,000 km. Analysts note that this Sajjil missile possibly had a 10 ton first stage and a 5 ton second stage.[15] This was the first known successful test of a two-stage Iranian missile or space rocket.

Fourth, Iran built multistage satellite launchers from its medium-range missiles. Tehran initially sought to develop a Shehab-4 satellite launch rocket, but announced its cancellation in November 2003. Iran's first two satellites were carried aboard Russian rockets in 2005. In January 2007, *Aviation Week* reported that Iran was building a 22-27 metric ton satellite launching rocket that had a Ghadr or Shehab-3 missile as its first stage.[16] Iran launched this rocket (or the first stage of such a rocket) in February 2007.

In 2008, Tehran launched three space rockets having one or two stages, though some may have been suborbital launches and none placed a satellite in orbit. In February 2008, it launched the Kavoshgar-1 (Explorer-1) rocket, describing this as the "first and determined step towards an Iranian satellite."[17] In August 2008, it launched the Safir (Messenger) rocket, noting that "the firing paved the way for placing the first Iranian satellite in orbit." The second stage of this two-stage rocket

[15] "Iran's missile development," *Strategic Comments,* Vol. 15, Issue 1, February 2009.

[16] Craig Covault, "Iran Appears Poised To Try Satellite Launch," *Aviation Week and Space Technology*, January 27, 2007.

[17] Charles Vick, "Second Safir-E-Omid Booster Orbital Launch Attempt," globalsecurity.org, August 19-28, 2008.

may have failed. In November 2008, Tehran launched the Kavoshgar-2 (Explorer-2). In February 2009, Tehran successfully launched its Omid satellite into orbit aboard the Safir rocket. This rocket had a first stage possibly derived from the Shehab-3 and had better storable liquid propellants in its second stage.[18]

Finally, Iran acquired anti-ship cruise missiles from China, such as the C-701 (Kosar) and C-802 (Noor).[19] The C-802 was supplied in the 1990s, and the C-701 in the 2000s, and Tehran reportedly upgraded or modified these missiles.[20] For example, it tested an air-launched C-802 and a radar-guided C-701 in 2006. Tehran also sought to convert the older Chinese-supplied C-601 Seersucker into land attack cruise missiles. In addition, it supplied the C-802 to Hezbollah, which hit an Israeli vessel with this missile in 2006.

*Missile Advances in North Korea*

North Korea maintained its 1999 missile test moratorium for almost seven years, but it still exported and developed missiles during the moratorium, and eventually resumed long-range missile tests.

In May and August 2001, Pyongyang stated that it would not test missiles until 2003. At a September 2002 summit with Japan's Prime Minister, it offered to extend this test moratorium beyond 2003. And during April 2003 talks in Beijing (after its January 2003 withdrawal from the NPT), Pyongyang outlined a plan to restrain its nuclear and missile programs, but this faltered. From 2003 to early 2006, North Korea tested new short-range missiles (but refrained from testing medium-range and long-range missiles); in March 2005, North Korea announced ending its moratorium on missile tests; in July 2006 and April 2009, it launched the long-range Taepodong-2 rocket.

First, North Korea tested the 100-200 km range KN-01 anti-ship cruise missile (an upgrade of the Chinese HY-2 Seersucker) on February 24, March 10, and April 1, 2003. This missile was tested ten times between February 2003 and June 2007, and possibly again in 2008 (North Korea tested either the KN-01 or other antiship cruise missiles in March, May, and October 2008).[21]

Second, North Korea developed its first solid-fuel ballistic missile, the 100-120 km range KN-02, derived from the Russian SS-21 (which North Korea reportedly received from Syria in 1996). It tested this missile twelve times between 2004 and 2007.

Third, North Korea developed a Nodong-B missile derived from the Soviet SS-N-6/R-27 (a 14 ton liquid-fuel missile deployed in the 1970s). This missile reportedly has a closed-cycle liquid-propulsion engine superior to that of the original Nodong, which gives it a range of approximately 2,500-3,000 km. The missile is believed to have been tested in Iran in January 2006. In April 2007, North Korea revealed the above three missiles at a military parade.

Fourth, North Korea ground-tested an engine for its 6,000 km range Taepodong-2 missile in May 2004. In July 2006, it unsuccessfully flight-tested its Taepodong-2, along with six other missiles—four Scud-Cs and two Nodongs. The Taepodong-2 broke up some 42 seconds after launch. Subsequently, North Korea reportedly ground-tested a Taepodong-2 engine in September 2008. In April 2009, it announced the launch of an experimental communications satellite,

[18] Uzi Rubin, "Yes, We Should Worry About Iran's Satellite," *Wall Street Journal*, February 21, 2009.

[19] "Firing Away; Missile In Iranian Exercise Underscores Extent of Guided-Weapon Ties Between Tehran and Beijing," *Aviation Week and Space Technology*, April 10, 2006.

[20] Even Medeiros, *A New Direction for China's Defense Industry* (Washington, DC: RAND, 2005).

[21] Joseph Bermudez, "Further Details Emerge of North Korean Ballistic Missiles," *Jane's Missiles and Rockets*, December 1, 2007.

Kwangmyongsong-2, aboard the Taepodong-2. However, observers noted that the rocket did not place a satellite in orbit; that the first stage fell into the Sea of Japan approximately 500 to 700 km from the launch site, as previously announced; and the second stage, and probably also the third stage with the satellite, fell into the Pacific some 3,000 km from the launch site, slightly short of the previously announced splash down location for the second stage. One analyst noted that, based on the declared trajectory of this satellite-launch attempt, the Taepodong-2 could carry a payload of 100 kg into an orbit of 400 km; a 500 kg payload to a range of 9,000 km; or a 1,000 kg payload to a range of 6,000 km.[22]

Beyond developing and testing missiles, North Korea continued its missile exports. During 2002-04, North Korea's missile exports to Libya, Yemen, and Pakistan probably ended. In November 2002, U.S. and Spanish naval vessels intercepted and then released a North Korean freighter carrying fifteen Scud missiles to Yemen, and Yemen pledged to not import additional missiles. In 2003, Libya curbed its missile programs and ended its missile imports from North Korea. Also, new details emerged of a July 1999 interdiction of a North Korean vessel in an Indian port.[23] This vessel was apparently heading to Libya with an assembly line for the production of Scud missiles. It carried tips of nose cones, sheet metal for rocket frames, machine tools, guidance systems, and engineering drawings labeled "Scud B" and "Scud C." Other reports noted that North Korea supplied Nodong missiles or their components to Pakistan in July 2002, but Pyongyang's missile transfers to Pakistan may have ended after U.S. missile sanctions in March-April 2003. Further, press reports in 2003-04 indicated that North Korea was interested in selling Scuds to Burma and Nigeria, but these sales may not have materialized.[24]

North Korea also transferred missile technology to Iran and Syria, though Washington and its allies blocked some of these transfers, as noted in the following pages that discuss the Proliferation Security Initiative.

## Chapter 3. Building a Supply Side Regime, and Chapter 8. Toward a Treaty Regime

In the 2000s, MTCR members sought to expand the regime's scope and domain; the Hague Code and UN Experts Groups explored ways to address missile issues; and states also undertook other initiatives and imposed sanctions in efforts to contain missile proliferation.

*Missile Nonproliferation Efforts - The MTCR*

The MTCR was chaired by Argentina in 2003-04, South Korea in 2004-05, Spain in 2005-06, Denmark in 2006-07, Greece in 2007-08, Australia in 2008-09, and Brazil in 2009-10. In terms of bureaucratic structure, the regime developed somewhat permanent chairs for its three main issues—intelligence, customs policy, and the technical annex. In terms of its core function, the regime updated its technology control lists.

For example, the MTCR plenary in 2002 began to address shortcomings regarding controls on cruise missiles and unmanned air vehicles (UAVs).[25] At this plenary, members established a new definition for the range of these systems, based on the most fuel-efficient flight profile,

[22] David Wright, "Examining North Korea's satellite launch vehicle," *Bulletin of the Atomic Scientists*, web edition, March 24, 2009.

[23] "This Ship Is Loaded," *Outlook India*, October 23, 2006; "On North Korean Freighter, a Hidden Missile Factory," *Washington Post*, August 14, 2003.

[24] "N. Korea Agrees to Share Missile Technology," *Los Angeles Times*, January 29, 2004; "Government Refuses N. Korean Arms Offer," *Los Angeles Times*, February 4, 2004; "Myanmar-North Korea Nuclear, Missile Cooperation Alleged," *Asian Export Control Observer* (April 2004) .

[25] Dennis Gormley, *Missile Contagion: Cruise Missile Proliferation and the threat to International Security* (Westport, CT: Praeger, 2008), pp. 152-154.

thereby covering a wider set of cruise missiles and UAVs. In 2006, MTCR members further tightened controls on cruise missile propulsion, guidance, and control systems. On another issue, from 2002 onward, regime members sought to limit terrorists from accessing MTCR-controlled items and UAVs. At their 2005 plenary, the regime addressed one aspect of this issue by adding controls on UAVs equipped with aerosol dispensers. The 2005 plenary also updated the MTCR annex and tightened controls on items such as accelerometers and liquid propellants, and the 2007 plenary further updated MTCR control lists.

In addition, the MTCR engaged in outreach efforts with non-members. These efforts in the early and mid-2000s included technical meetings on export controls with China, Libya, Israel, and Serbia; discussions with Libya and Yemen to discourage them from buying North Korean technologies; and promoting the MTCR among regional forums such as the Arab League and the Shanghai Cooperation Organization.

Further, the MTCR recognized missile nonproliferation measures of the UN by supporting UN Security Council Resolution 1540, which mandated that all states adopt export controls; agreeing that its chair pursue contact with the UN's 1540 Committee; and noting the "direct relevance . . . to MTCR export controls" of UN Security Council Resolutions 1695, 1696, 1718, 1737, 1747, 1803, and 1835 (resolutions adopted from 2006 to 2008 concerning North Korea's and Iran's missile programs).

In terms of members, the MTCR admitted Bulgaria as its thirty-fourth member in 2004. At the time, it considered admitting nine additional states (including seven new entrants to the European Union),[26] but had not admitted them as of early 2009. China indicated its willingness to join the MTCR in 2003, and the MTCR held detailed technical discussions with China in 2004, but the group eventually did not approve Beijing's membership. India adopted legislation and policies that brought its export controls closer to MTCR guidelines in and after 2005; in 2005, MTCR partners welcomed New Delhi's intention to adhere to the regime; New Delhi declared its adherence with the MTCR in a September 2008 letter to the MTCR's Point of Contact in Paris. The MTCR also held three meetings with Pakistan between 2003 and 2006, and Islamabad noted that its export control measures of 2004 and 2005 encompassed MTCR guidelines.

*Missile Nonproliferation Efforts—the Hague Code*

The Hague Code of Conduct Against Ballistic Missile Proliferation (HCOC) expanded its membership from 93 in November 2002 to 124 by June 2006 and 130 by early 2009. The HCOC was chaired by the Netherlands (November 2002 to October 2003), Chile (October 2003 to June 2004), the Phillipines (two terms from June 2004 to June 2006), Morocco (June 2006 to June 2007), Bosnia-Herzogovina (June 2007 to June 2008), Hungary (June 2008 to 2009), and Costa Rica (2009 to 2010). It held its second to seventh regular meetings in October 2003, November 2004, June 2005, June 2006, May 2007, and June 2008.

In its early years, the HCOC sought to expand its membership by creating links with the UN. Thus, the HCOC's October 2003 plenary was held in New York just before the UN First Committee meetings. In the following years, HCOC members drafted resolutions for UN First Committee sessions. The UN General Assembly adopted these resolutions at its 59th (2004), 60th (2005), and 63rd (2008) sessions, which

[26] The MTCR's September 2003 press statement noted that "Based on applications from several states the question of membership was actively considered," though it did not specify the states.

invited non-subscribing states to join the Hague Code. Further, in official communications with the UN Secretary General and the 1540 Committee of the UN Security Council, the HCOC chair highlighted the complementary work of the UN and the HCOC.

The HCOC's outreach activity included a September 2005 seminar in Manila that encouraged Asian countries to subscribe to the Code, and a March 2008 seminar for Middle Eastern states. Further, as part of the Code's confidence-building measures, international observers were invited to space launch sites in Norway in December 2004 and Japan in November 2005. Observers from Canada, France, Germany, Norway, Russia and the United States visited Japan's Tanegashima Space Center in November 2005.

The European Union also promoted the HCOC. As part of its 2003 Strategy against the Proliferation of Weapons of Mass Destruction, the EU supported multilateral nonproliferation and confidence building measures. It noted that the Hague Code was an integral part of these measures. The EU aimed to secure universal membership and better implementation for the HCOC.

In 2005, the EU campaigned in the UN First Committee for renewed broad endorsement of a resolution on the HCOC. In 2007, to canvass support for the Code and its conceptual basis, the EU organized a workshop at the time of the HCOC annual meeting, in which nine important non-subscribing states participated. Germany's government, during its term as EU President in 2007, issued demarches urging states not yet in the HCOC to subscribe to it and urging subscribing states to fully implement the Code, and this resulted in better attendance at the 2007 HCOC meeting. In 2008, the European Council allocated one million euros and tasked the Foundation for Strategic Research in Paris (FRS) with projects to advance the Code. These included outreach projects in regions with a high percentage of non-subscribing states (Africa); financial and technical support for information exchanges (through an internet-based information and communication mechanism (e-ICC)); similar support for visits to space launch vehicle testing sites; and discussions on institutional and legal frameworks related to missile nonproliferation.

The EU also drew attention to weaknesses with subscribing states' submissions of pre-launch notifications for missile tests, annual declarations on missiles, and attendance at HCOC meetings.[27] Further, it expressed concern at Russia's decision in early 2008 to suspend its submission of pre-launch notifications for one year. Moscow noted that HCOC members did not adopt a Russian proposal to make the Code's annual reports and pre-launch notifications more optional rather than politically binding, a proposal that it anticipated would attract more members. It added that some HCOC members (presumably meaning the United States) were not issuing pre-launch notifications under the Code, though both Washington and Moscow notify each other of missile launches bilaterally under separate arrangements.[28]

In addition, the EU regretted the failure of HCOC states to agree on a resolution for the UN General Assembly session in 2007. Other states observed technical shortcomings with the Hague Code. For example, in its 2007 statement, Ukraine noted that it was necessary to formally define the term "ballistic missile," and it suggested applying definitions in accordance with MTCR guidelines.

Overall, by early 2009, despite its outreach efforts, many missile-possessing states remained outside the Hague Code. Separately, in October 2005, Pakistan and India signed a bilateral agreement on the

[27] "Statement of the Republic of Slovenia on behalf of the European Union, 7th Regular Meeting of the Hague Code of Conduct against Ballistic Missile Proliferation" Vienna, May 29-30, 2008.

[28] "Russia Halts Missile Launch Notices," *Arms Control Today*, March 2008.

pre-notification of missile tests—thus both countries were following one important practice of the Hague Code even though they did not join the Code.

*The United Nations Expert Group*

Three UN Experts groups (each with representatives from 23 states) discussed the issue of missiles and missile proliferation. The first group was established following General Assembly resolution 55/33 (October 2000), and met from July 2001 to July 2002. Its report was welcomed by General Assembly resolutions 57/75 (2002) and 58/37 (2003), which established the second group. This group met three times in 2004 and did not produce a final report.

The third group was established pursuant to General Assembly resolution 59/67 (October 2004), which requested the Secretary General to form an experts group in 2007. The group held three meetings between June 2007 and June 2008. Its report did not specify any particular set of actions, and instead noted that a step-by-step approach could be adopted to tackle missile proliferation. It mentioned that this approach could include tightening export controls, reporting missile-related information to UN mechanisms; and voluntary transparency and confidence-building measures.

*The Proliferation Security Initiative*

Eleven countries initiated the Proliferation Security Initiative (PSI) in 2003, and some 90 countries had stated that they would participate in the PSI by 2009. The initiative sought to interdict ships and aircraft carrying missiles and weapons of mass destruction to states of concern.

PSI participants (and states not formally joining PSI) interdicted missile technology transfers to Iran at least five times—in 2004-05, June 2005, November 2006, April 2007, and August 2008. The 2004-05 intercept was noted by Secretary of State Condoleezza Rice in May 2005, when she mentioned that PSI members had undertaken 11 intercepts during the previous year and had blocked missile technology transfers to Iran. In June 2005, at the request of Washington, China and a Central Asian nation denied overflight permission to an Iranian plane flying from Iran to North Korea.[29] In November 2006, acting under UN Security Council resolution 1696, an unspecified country stopped an Asian company's transfer of chromium-nickel steel plates (used in missile components) to Iran.[30] In April 2007, a shipment of sodium perchlorate (used for solid-fuel propellant) to Iran was detoured to an Asian port, whose government sent the shipment back to the country of origin. This shipment was intended for an Iranian entity barred from receiving missile technologies by UN Security Council Resolution 1737. In August 2008, India denied overflight permission to a North Korean plane delivering a suspected missile cargo to Iran.[31]

PSI participants also interdicted two missile technology transfers to Syria in 2007. In February 2007, equipment bound for Syria that could be used to test ballistic missiles was seized by port authorities in an unspecified country—four PSI countries worked to interdict this equipment.[32] In June 2007, a Syrian plane flying to North Korea was denied overflight rights and could not land in Pyongyang, and the states involved may have acted under UN Security Council Resolution 1737.

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[29] "U.S. Widens Campaign on North Korea," *New York Times*, October 24, 2005.

[30] Wade Boese, "Interdiction Initiative Successes Assessed," *Arms Control Today*, July/August 2008.

[31] "North Korean Plane Was Grounded at U.S. Request," *Wall Street Journal*, November 1, 2008.

[32] "Syria-bound missile components intercepted, claims US," *The Telegraph*, May 29, 2008.

*Missile Nonproliferation Sanctions*

The United States sanctioned numerous foreign entities for missile-relevant activity and technology transfers.[33] One report on U.S. missile sanctions, for MTCR violations under two export control acts, noted ten such sanctions since 2001.[34] It noted that Washington had sanctioned firms in China and Pakistan (September 2001), North Korea (August 2002), North Korea and Pakistan (March-April 2003), Moldova (May 2003), China (September 2003), the activities of the Chinese government (unspecified dates in 2003), Macedonia (December 2003), Russia (July 2004), North Korea (September 2007), and three firms in North Korea and in two China (February 2009). Another source reported that Washington imposed nonproliferation sanctions on Chinese firms and entities twice in 2002, four times in 2003, five times in 2004, once in 2005, three times in 2006, and once in 2007 (the sanctions in 2003, 2004 and 2006 specifically mentioned missile-related activity).[35] Most of the sanctions were imposed under Executive Orders 12938 and 13094, the Iran Nonproliferation Act, and the Iran and Syria Nonproliferation Act, and probably involved transfers to Iran of cruise missile technology, technologies for missile guidance and other missile components, and testing equipment.

The United Nations adopted resolutions 1695 and 1718 concerning North Korea (in response to its July 2006 missile tests and October 2006 nuclear test), and resolutions 1696, 1737, 1747, 1803, and 1835 concerning Iran's nuclear programs but also covering its missile programs. These resolutions called on countries to prevent these states from procuring missiles and related technologies; to obstruct financial transactions related to these programs; and imposed technology transfer restrictions and other sanctions on missile-related entities in these states.

*The NPT Nuclear States: China, Russia, France, UK, and the US*

China developed the approximately 7,200-8,000 km range DF-3 missile, a submarine-launched version of this missile (the JL-2), and an extended-range version (the 10,000-11,000 km range DF-31).[36] These solid-fuel missiles were tested seven times between 1999 and 2006. These included DF-31 tests in August 1999, November 2000, December 2000, and November 2002 (some of these were unsuccessful); JL-2 sea-launched tests in July 2004 and June 2005 (at least one failed); and a test in September 2006, which could have involved the DF-31A.

In addition, China used a medium-range solid-fuel missile (reportedly a modified DF-21) to hit a satellite in January 2007; its previous antisatellite tests (using the DF-21 or another missile), in July 2005 and

[33] The Bush administration imposed nonproliferation sanctions about 280 times against 200 entities—some for missile-related activity though most for other nonproliferation activity. Of the 110 sanctions from 2001-04, about 60 were on thirty Chinese entities, and some 40 of these were for transactions with Iran. Of the 170 sanctions from 2005-08, 96 were on Iranian entities and 16 on Chinese entities, and over 100 of the second-term sanctions were imposed by the Treasury department. Wade Boese, "Type, Targets of Sanctions Shift in Bush Administration," *Arms Control Today*, October 2008.

[34] Department of State, Fact Sheet, "Missile Sanctions Law," http://www.state.gov/t/isn/c15232.htm

[35] Washington sanctioned Chinese entities in May 2002 (along with two Armenian and two Moldovan entities), July 2002, May 2003 (these mentioned missile transfers to Iran), July 3, 2003 (along with a North Korean firm), July 24, 2003 (these mentioned missile proliferation activities), September 2003 (these mentioned missile proliferation activities), March 2004 (along with entities in Russia, Belarus, Macedonia, and North Korea), September 2004 (these mentioned missile proliferation activities), September 2004 (along with firms in Belarus, North Korea, Russia, and Ukraine), November 2004 (along with a firm in North Korea), December 2004 (along with firms in Taiwan and North Korea), December 2005, June 2006 (for missile-related technology transfer), August 2006, December 2006, and April 2007. Nuclear Threat Initiative, "U.S. Nonproliferation Sanctions Against China And/Or Chinese Entities," http://www.nti.org/db/China/sanclist.htm

[36] Robert Norris and Hans Kristensen, "Chinese Nuclear Forces, 2008," *Bulletin of the Atomic Scientists*, July/August 2008.

February 2006, failed.[37] Other reports noted that China was developing two solid-fuel short-range missiles, both of which could be offered for export—the 50 to 150 km range P12 that weighed 2.1 tons (including a 450 kg warhead), and the 60 to 260 km range B611 that weighed 2.2 tons (including a 480 kg warhead).[38]

Russia tested new long-range missiles derived from its 11,000 km range SS-27/Topol-M, a 47 ton three-stage solid-fuel missile. In 2000, it first tested a mobile version of the Topol-M (whose 11 previous tests involved silo-launched missiles). In 2005, the Topol-M (or the older SS-25) was tested with a new maneuvering warhead. Also in 2005, Russia conducted the first flight-test of the submarine-launched Bulava. This 36 ton missile is derived from the Topol-M with a reduced length and 8,000 km range. The missile was flight-tested twice in 2005, three times in 2006 (all three tests failed), possibly twice in 2007 (one test may have failed), and three times in 2008 (one test failed).

In addition, Russia developed an RS-24 multiple-warhead missile, which first flew in 2007. Some reports note that this missile is essentially a three-warhead version of the single-warhead Topol-M.[39] Others note that the RS-24 can carry six to ten warheads, and may use a modified Topol-M with a larger first stage, or may have technology or stages from another missile.

France tested its new M-51 submarine-launched ballistic missile in November 2006, with further tests in June 2007 and November 2008. This approximately 50 ton three-stage solid-fuel missile has a range of over 6,000 km (some reports note a range of 8,000 to 10,000 km).

Britain and the United States tested existing missiles but did not develop new missiles. The submarine-launched Trident-D5 was tested typically three to six times each year in the 2000s—mostly by the U.S. navy, with approximately one test each year by the British navy. In total, from 1989 to early 2009, the missile was flight-tested 126 times. Also, the United States retired its 50 MX/Peacekeeper missiles by 2005, and, by July 2008, it had reduced its Minuteman-3 fleet from 500 to 450 missiles. It flight-tested a few Minuteman-3 missiles each year, with four tests in 2006 and one in 2007.

One other area of missile activity concerned long-range cruise missiles.[40] China tested a new 1,500 km range Dong Hai-10 land-attack cruise missile in September 2004. Ukraine sought to develop the Korshun cruise missile based on the 3,000 km range Soviet-era air launched Kh-55. Also, Ukrainian arms dealers sold 12 to 20 Kh-55 cruise missiles to Iran and China (including at least six to Iran) in 2001. Russia reportedly developed a new Kh-555, which was better than the Kh-55 as it had a longer range, new optical and satellite guidance, a low radar cross-section, and a variable flight profile. In May 2007, it also tested a new ground-launched cruise missile, the R-500 or Iskander-K, which could be deployed from the same launcher as the Iskander ballistic missile.

For further updates, see
http://homepages.uc.edu/~mistrydj/ContainingMissileProliferation

[37] "U.S. Knew of China's Missile Test, but Kept Silent," *New York Times*, April 23, 2007.

[38] Christopher Foss, "Chinese P12 Tactical SSM System in Final Trials," *Jane's Defence Weekly*, March 23, 2007; Christopher Foss, "China Approves New Surface-to-Surface Missiles to Export," *International Defence Review*, April 19, 2007.

[39] Pavel Podvig, "Russia's new arms development," *The Bulletin of the Atomic Scientists*, web edition, January 16, 2009.

[40] Dennis Gormley, *Missile Contagion: Cruise Missile Proliferation and the threat to International Security* (Westport, CT: Praeger, 2008), pp. 47-65.