VII. Pakistani nuclear forces

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Pakistan is estimated to possess 90–110 nuclear weapons that can be delivered by aircraft and missiles (see table 7.8). Pakistan's current warhead designs are believed to use highly enriched uranium (HEU), but there is evidence that it is moving towards an arsenal based on plutonium. Warheads using plutonium could be lighter and more compact than those using HEU to achieve the same yield. Some experts have estimated that Pakistan's nuclear stockpile could double within a decade based on increased military plutonium-production capabilities.[1]

Pakistan is expanding its plutonium-production capabilities at the nuclear complex at Khushab, Punjab. The complex currently consists of three heavy water nuclear reactors and a heavy water production plant. A fourth heavy water reactor is under construction. All four reactors appear to be capable of generating the same amount of power.[2] Its first plutonium production reactor, the 40–50-megawatt-thermal Khushab-I, is estimated to produce 5.7–11.5 kilograms of plutonium annually, depending on operational efficiency, enough for 1–3 nuclear weapons, depending on weapon design and fabrication skills.[3] A second plutonium production reactor, Khushab-II, may have commenced operation in late 2009 or 2010.[4] The first weapon-grade plutonium from Khushab-II could have become available in 2011.[5] Construction work on a third reactor at the Khushab site began in 2006 and seems to have been completed in late 2011, based on recent open source satellite imagery. Satellite imagery also indicates that work on a fourth reactor also started in late 2010.[6] Rumours of possible Chinese assistance in building the fourth reactor appear to have been unfounded.[7] The Khushab nuclear complex, combined with the annual HEU production, could increase Pakistan's annual nuclear warhead production capacity several-fold. This will depend, however, on the country

[1] Norris, R. S. and Kristensen, H. M., 'Nuclear notebook: Pakistan's nuclear forces, 2011', *Bulletin of the Atomic Scientists*, vol. 67, no. 4 (July 2011), p. 91.

[2] International Panel on Fissile Materials (IPFM), *Global Fissile Material Report 2011: Nuclear Weapon and Fissile Material Stockpiles and Production* (IPFM: Princeton, NJ, Jan. 2012), p. 19.

[3] International Panel on Fissile Materials (IPFM), *Global Fissile Material Report 2010: Balancing the Books: Production and Stocks* (IPFM: Princeton, NJ, Dec. 2010), p. 132.

[4] Brannan, P., 'Steam emitted from second Khushab reactor cooling towers; Pakistan may have started operating second reactor', Institute for Science and International Security (ISIS) Report, 24 Mar. 2010, <http://isis-online.org/isis-reports/category/pakistan/>.

[5] International Panel on Fissile Materials (note 3).

[6] Albright, D. and Brannan, P., 'Pakistan appears to be building a fourth military reactor at the Khushab nuclear site', Institute for Science and International Security (ISIS) Report, 9 Feb. 2011, <http://isis-online.org/isis-reports/category/pakistan/>.

[7] Hibbs, M., 'Chinese help on Khushab-4?', Arms Control Wonk, 22 Feb. 2011, <http://hibbs.armscontrolwonk.com/archive/162/>. See also chapter 8, section V, in this volume.

Table 7.8. Pakistani nuclear forces, January 2012

Type	Range (km)[a]	Payload (kg)	Status
Aircraft			
F-16A/B	1 600	4 500	Currently undergoing mid-life upgrades, to be completed 2013–14
Mirage III/V	2 100	4 000	Used to test launch dual-capable Ra'ad cruise missile
Land-based ballistic missiles			
Abdali (Hatf-2)	~180	200–400	Under development; test-launched on 11 Mar. 2011
Ghaznavi (Hatf-3)[b]	290	500	Entered service with the Pakistani Army in 2004; fewer than 50 launchers deployed; most recent test launch on 8 May 2010
Shaheen I (Hatf-4)[c]	650	750–1 000	Entered service with the Pakistani Army in 2003; fewer than 50 launchers deployed; most recent test launch on 8 May 2010
Shaheen II (Hatf-6)	2 500	(~1 000)	Under development; expected to become operational soon
Ghauri I (Hatf-5)	>1 200	700–1 000	Entered service with the Pakistani Army in 2003; fewer than 50 launchers deployed; most recent test-launch on 20 Dec. 2010
Nasr (Hatf-9)	~60	. .	Under development; first test launch on 19 Apr. 2011
Cruise missiles			
Babur (Hatf-7)[c]	600	400–500	Under development; most recent test-launch on 28 Oct. 2011
Ra'ad (Hatf-8)	350	. .	Under development; air-launched; most recent test launch on 29 Apr. 2011

. . = not available; ( ) = uncertain figure.

[a] Aircraft range is for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading. Missile payloads may need to be reduced in order to achieve maximum range.

[b] The Hatf-3 is believed to be a copy of the M-11 missile acquired from China in the 1990s.

[c] An extended-range version, the Shaheen IA, is under development.

[d] Sea- and air-launched versions are reportedly also under development.

Sources: US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, OH, June 2009); US Central Intelligence Agency, 'Unclassified report to Congress on the acquisition of technology relating to weapons of mass destruction and advanced conventional munitions, 1 January through 30 June 2002', Apr. 2003, <https://www.cia.gov/library/reports/archived-reports-1/>; US National Intelligence Council, 'Foreign missile developments and the ballistic missile threat through 2015' (unclassified summary), Dec. 2001, <http://www.dni.gov/nic/special_missile threat2001.html>; International Institute for Strategic Studies, *The Military Balance 2006–2007* (Routledge: London, 2007); 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and authors' estimates.

having sufficient capacity to reprocess spent fuel as well as an adequate supply of uranium to fuel the reactors at Khushab.[8]

[8] Albright, D. and Brannan, P., 'Commercial satellite imagery suggests Pakistan is building a second much larger plutonium production reactor: is South Asia headed for a dramatic buildup in

As of 2011 Pakistan was estimated to have a stockpile of 2.35–3.15 tonnes of 90 per cent HEU (see section X below). The enrichment is believed to be taking place at the uranium centrifuge facilities at Kahuta and Gadwal.

Strike aircraft

The Pakistani Air Force (PAF) is believed to have previously given a nuclear delivery role to some of the F-16A/B combat aircraft supplied by the USA in the 1980s.[9] It is unclear whether the aircraft are currently assigned nuclear missions. The PAF also operates Mirage III and V combat aircraft, which have been upgraded with new avionics to augment their strike capabilities and could have a nuclear delivery role. The range of the Mirage aircraft has been extended by the PAF's development of an aerial refuelling capability using Il-78 aircraft.

Pakistan is also developing an air-launched cruise missile, known as the Ra'ad (Hatf-8), which will have a range of 350 kilometres. The latest test launch was conducted on 29 April 2011. According to the Pakistani Inter Services Public Relations, the Ra'ad is a dual-capable cruise missile with 'stealth capabilities' that 'enabled Pakistan to achieve greater strategic stand off capability on land and at sea'.[10]

Land-based missiles

Pakistan's operational nuclear-capable ballistic missile arsenal is of three types. The Ghaznavi (Hatf-3) is a solid-fuelled, road-mobile short-range ballistic missile (SRBM) that was inducted into service with the Pakistani Army in 2004. The solid-fuelled Shaheen I (Hatf-4) SRBM entered into service in 2003. The liquid-fuelled Ghauri I (Hatf-5), which is based on the North Korean Nodong missile, is Pakistan's only operational medium-range ballistic missile (MRBM).

Pakistan's National Defence Complex is developing additional types of nuclear-capable ballistic missile: the medium-range Shaheen IA and Shaheen II (Hatf-6) and the short-range Abdali (Hatf-2) and Nasr (Hatf-9). The Shaheen IA is an extended-range version of the Shaheen I. The Shaheen II is a two-stage, solid-fuelled, road-mobile missile that may eventually replace the Ghauri MRBM. It has been under development for more than a decade and may soon become operational.

nuclear arsenals', Institute for Science and International Security (ISIS) Report, 24 July 2006, <http://isis-online.org/isis-reports/category/pakistan/>.

[9] US National Security Council, 'Report to Congress on status of China, India and Pakistan nuclear and ballistic missile programs', 28 July 1993, obtained under the US Freedom of Information Act by the Federation of American Scientists, <http://fas.org/irp/threat/930728-wmd.htm>, p. 7.

[10] Pakistani Inter Services Public Relations, Press Release no. PR104/2011-ISPR, 29 Apr. 2011, <http://www.ispr.gov.pk/front/main.asp?o=t-press_release&date=2011/4/29>.

On 11 March 2011 Pakistan conducted a test launch of the Abdali (Hatf-2) SRBM. The purpose of the test was to validate 'technical improvements' to the missile.[11] The Abdali programme began in the 1980s but was terminated in 1994. In 1997 Pakistan restarted work on a new design for the missile with a reduced range. The missile, which was first flight-tested in 2002, may have a nuclear capability.[12]

On 19 April 2011 Pakistan conducted the first flight test of the nuclear-capable Nasr (Hatf-9) SRBM.[13] The Nasr is as a road-mobile, solid-fuelled missile that appears to be designed to carry a new, highly compact nuclear warhead suitable for battlefield use.[14] Khalid Ahmed Kidwai, Director of the Strategic Plans Division, described the test as consolidating Pakistan's strategic deterrence capability 'at all levels of the threat spectrum', providing a 'short range missile capability in addition to the already available medium and long range ballistic missiles and cruise missiles'.[15]

On 28 October 2011 Pakistan conducted the latest in a series of flight tests of the Babur (Hatf-7), a nuclear-capable ground-launched cruise missile. The 600 km-range missile was launched from a new three-tube, road-mobile missile launch vehicle that is designed for enhanced 'target employment and survivability'.[16] Pakistan's missile development organization, the National Engineering and Scientific Commission (NESCOM), is reportedly working to extend the range of the missile to up to 1000 km.[17]

Pakistan's development of new types of nuclear-capable cruise missiles and SRBMs may be an indication of its growing concern about being able to counter India's superior conventional forces and its nascent ballistic missile defences. The Abdali and Nasr missile programmes further suggest that Pakistan's strategic planning has evolved to include a wider range of contingencies for the use of nuclear weapons. According to some Pakistani defence experts, the country has been forced to develop battlefield nuclear weapons in response to the Indian Army's Cold Start doctrine, under which India is prepared to carry out rapid but limited conventional attacks on Pakistani territory using forward-deployed mechanized forces.[18]

[11] Pakistani Inter Services Public Relations, Press Release no. PR62/2011-ISPR, 11 Mar. 2011, <http://www.ispr.gov.pk/front/main.asp?o=t-press_release&id=1689>.

[12] Lennox, D. (ed.), *Jane's Strategic Weapon Systems*, no. 54 (IHS Global Limited: Coulsdon, 2011) p. 120.

[13] Pakistani Inter Services Public Relations, Press Release no. PR94/2011-ISPR, 19 Apr. 2011, <http://www.ispr.gov.pk/front/main.asp?o=t-press_release&id=1721>.

[14] Ansari, U., 'Pakistan tests "nuke-capable" short-range missile', *Defense News*, 20 Apr. 2011.

[15] Pakistani Inter Services Public Relations (note 13).

[16] Pakistani Inter Services Public Relations, Press Release no. PR256/2011-ISPR, 28 Oct. 2011, <http://www.ispr.gov.pk/front/main.asp?o=t-press_release&date=2011/10/28>.

[17] Associated Press of Pakistan, 'Government has prepared comprehensive plan to equip armed forces: Musharraf', 30 May 2008, <http://www.app.com.pk/en_/index.php?option=com_content&task=view&id=9898&Itemid=2>.

[18] Ansari (note 14); Reuters, 'Pakistan builds low yield nuclear capability', *Dawn*, 15 May 2011; and 'Hatf- IX test-fired', *The Nation*, 20 Apr. 2011.