

## VII. Pakistani nuclear forces

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Pakistan continues to prioritize the development and deployment of new nuclear weapons and delivery systems as part of its 'full spectrum deterrence posture' vis-à-vis India. It is estimated that Pakistan possessed 150–60 warheads as of January 2019 (see table 6.8). Pakistan's nuclear weapon arsenal is likely to continue to expand over the next decade, although estimates of the increase in warhead numbers vary considerably.<sup>1</sup>

Pakistan is believed to be gradually increasing its military fissile material holdings, which include both weapon-grade plutonium and highly enriched uranium (HEU) (see section X). Pakistan's plutonium production complex is located at Khushab in the province of Punjab. It consists of four operational heavy water nuclear reactors dedicated to the production of plutonium for nuclear weapons and a heavy water production plant.<sup>2</sup> Pakistan appears to be increasing its capacity to reprocess spent nuclear fuel, that is, to chemically separate plutonium from irradiated reactor fuel. A small reprocessing plant has been expanded at the New Laboratories facility of the Pakistan Institute of Science and Technology (PINSTECH) near Rawalpindi. A larger reprocessing plant has been constructed at the Chashma Nuclear Power Complex in Punjab and may be operational, although construction appeared to be continuing in 2018.<sup>3</sup>

Uranium enrichment takes place at the gas centrifuge plant at the Khan Research Laboratories (KRL) complex at Kahuta in Punjab, and at a smaller plant located at Gadwal, also in Punjab. The Gadwal plant is dedicated to making weapon-grade uranium for nuclear weapons using low enriched uranium from the KRL plant.<sup>4</sup> A new gas centrifuge uranium enrichment plant is under construction at the KRL complex, but it is unclear whether the plant will produce enriched uranium for civil or military purposes.<sup>5</sup>

<sup>1</sup> See e.g. Sundaresan, L. and Ashok, K., 'Uranium constraints in Pakistan: How many nuclear weapons does Pakistan have?', *Current Science*, vol. 115, no. 6 (25 Sep. 2018); Kristensen, H., Norris, R. and Diamond, J., 'Pakistani nuclear forces, 2018', *Bulletin of the Atomic Scientists*, vol. 74, no. 5 (Aug. 2018); and Salik, N., 'Pakistan's nuclear force structure in 2025', Carnegie Endowment for International Peace, Regional Insight, 30 June 2016.

<sup>2</sup> Burkhard, S., Lach, A. and Pabian, F., 'Khushab update', Institute for Science and International Security, Report, 7 Sep. 2017.

<sup>3</sup> As of Feb. 2018, the Chashma reprocessing plant was reported to be 'under construction'. International Panel on Fissile Materials, 'Facilities: Reprocessing plants', Feb. 2018. Moreover, Digital Globe satellite images taken on 19 Sep. and 10 Oct. 2018 and provided by Google Earth show significant new construction adjacent to the suspected main reprocessing hall.

<sup>4</sup> Albright, D., Burkhard, S. and Pabian, F., 'Pakistan's growing uranium enrichment program', Imagery Brief, Institute for Science and International Security, 30 May 2018.

<sup>5</sup> Albright, Burkhard and Pabian (note 4).

Pakistan's capacity to produce HEU for nuclear weapons is constrained by its limited indigenous supply of natural uranium.<sup>6</sup>

### **Aircraft**

The aircraft that are most likely to have been given a nuclear delivery role are the Pakistan Air Force's (PAF) Mirage III and Mirage V combat aircraft. The Mirage III has been used for developmental test flights of the nuclear-capable Ra'ad air-launched cruise missile (ALCM), while the Mirage V is believed to have been given a strike role with nuclear gravity bombs.<sup>7</sup>

Pakistan procured 40 F-16A/B combat aircraft from the United States in the mid 1980s. There are credible but unconfirmed reports that some of these aircraft were modified by Pakistan for a nuclear weapon delivery role and many analysts believe that they continue to have this role.<sup>8</sup>

Pakistan is acquiring the JF-17 combat aircraft, a multi-role lightweight fighter jointly developed with China, to replace the ageing Mirage aircraft. There are reports that the PAF intends to integrate the dual-capable Ra'ad ALCM (see below) on to the JF-17, although whether this signifies a nuclear delivery role for the aircraft is unclear.<sup>9</sup>

### **Land-based missiles**

Pakistan is expanding its nuclear-capable ballistic missile arsenal, which consists of a series of short- and medium-range systems. It currently deploys the Abdali (also designated Hatf-2), the Ghaznavi (Hatf-3) Shaheen-I (Hatf-4) and Nasr (Hatf-9) solid-fuelled, road-mobile short-range ballistic missiles (SRBMs). An extended-range version of the Shaheen-I, the Shaheen-IA, is still in development.

Pakistan deploys two types of nuclear-capable medium-range ballistic missile (MRBM): the liquid-fuelled, road-mobile Ghauri (Hatf-5) with a range of 1250 kilometres; and the two-stage, solid-fuelled, road-mobile Shaheen-II (Hatf-6) with a range of 2000 km.<sup>10</sup> A longer-range variant, the Shaheen-III, is currently in development and was first test launched in 2015.<sup>11</sup> The missile

<sup>6</sup> International Panel on Fissile Materials (IPFM), 'Pakistan may be building a new enrichment facility', IPFM Blog, 16 Sep. 2016.

<sup>7</sup> Kerr, P. and Nikitin, M. B., *Pakistan's Nuclear Weapons*, Congressional Research Service (CRS) Report for Congress RL3248 (US Congress, CRS: Washington, DC, 1 Aug. 2016), p. 7.

<sup>8</sup> See Kristensen, Norris and Diamond (note 1).

<sup>9</sup> Fisher, R., 'JF-17 Block II advances with new refuelling probe', *Jane's Defence Weekly*, 27 Jan. 2016.

<sup>10</sup> US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, OH, July 2017), p. 25.

<sup>11</sup> Pakistan Inter Services Public Relations, 'Shaheen 3 missile test', Press Release PR-61/2015-ISPR, 9 Mar. 2015.

**Table 6.8.** Pakistani nuclear forces, January 2019

Type (US/Pakistani designation)	Launchers deployed	Year first deployed	Range (km) <sup>a</sup>	Warheads x yield <sup>b</sup>	No. of warheads <sup>c</sup>
<i>Aircraft</i>	36				36
F-16A/B <sup>d</sup>	24	1998	1 600	1 x bomb	24
Mirage III/V	12	1998	2 100	1 x bomb or Ra'ad ALCM	12
<i>Land-based missiles</i>	102 <sup>e</sup>				102
Abdali (Hatf-2)	10	(2015)	200	1 x 5–12 kt	10
Ghaznavi (Hatf-3)	16	2004	300	1 x 5–12 kt	16
Shaheen-I (Hatf-4)	16	2003	750	1 x 5–12 kt	16
Shaheen-IA (Hatf-4) <sup>f</sup>	..	(2019)	900	1 x 5–12 kt	..
Shaheen-II (Hatf-6)	12	2014	2 000	1 x 10–40 kt	12
Shaheen-III (Hatf-6) <sup>g</sup>	..	(2018)	2 750	1 x 10–40 kt	..
Ghauri (Hatf-5)	24	2003	1 250	1 x 10–40 kt	24
Nasr (Hatf-9)	24	(2013)	60–70	1 x 5–12 kt	24
Ababeel (Hatf-. .)	0	..	2 200	MIRV or MRV	0 <sup>h</sup>
<i>Cruise missiles</i>	12				12
Babur GLCM (Hatf-7)	12	2014	350 <sup>i</sup>	1 x 5–12 kt	12
Babur-2 GLCM (Hatf-. .)	..	.. <sup>j</sup>	700	1 x 5–12 kt	..
Babur-3 SLCM (Hatf-. .)	0	.. <sup>k</sup>	450	1 x 5–12 kt	0
Ra'ad ALCM (Hatf-8) <sup>l</sup>	..	(2019)	350	1 x 5–12 kt	..
<b>Total</b>					<b>150–160<sup>m</sup></b>

.. = not available or not applicable; () = uncertain figure; ALCM = air-launched cruise missile; GLCM = ground-launched cruise missile; kt = kiloton; MIRV = multiple independently targetable re-entry vehicle; MRV = multiple re-entry vehicle; SLCM = sea-launched cruise missile.

<sup>a</sup> Aircraft range is for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading. Missile payloads may have to be reduced in order to achieve maximum range.

<sup>b</sup> The yields of Pakistan's nuclear warheads are not known. The 1998 nuclear tests demonstrated a yield of up to 12 kt. Since then, it is possible that boosted warheads have been introduced with higher yields. There is no open-source evidence that Pakistan has developed two-stage thermonuclear warheads.

<sup>c</sup> Aircraft and several missile types are dual-capable. Cruise missile launchers carry more than 1 missile. This estimate counts an average of 1 warhead per launcher. Warheads are not deployed on launchers but kept in separate storage facilities.

<sup>d</sup> There are unconfirmed reports that some of the 40 F-16 combat aircraft procured from the USA in the 1980s were modified by Pakistan for a nuclear weapon delivery role.

<sup>e</sup> Some launchers might have 1 or more reloads of missiles.

<sup>f</sup> It is unclear whether the Shaheen-IA has the same designation as the Shaheen-I.

<sup>g</sup> It is unclear whether the Shaheen-III has the same designation as the Shaheen-II.

<sup>h</sup> According to the Pakistani military, the missile is 'capable of delivering multiple warheads', using MIRV technology.

<sup>i</sup> The Pakistani Government claims the range is 700 km, double the range reported by the US Air Force National Air and Space Intelligence Center (NASIC).

<sup>j</sup> The Babur-2, which was first test launched on 14 Dec. 2016, is an improved version of the original Babur GLCM and will probably replace it.

<sup>k</sup> The first test launch of a Babur-3 SLCM was carried out from an underwater platform on 9 Jan. 2017.

<sup>l</sup>In 2017 the Pakistani military displayed a Ra'ad-II variant with a reported range of 550 km. The new version has yet to be deployed.

<sup>m</sup>In addition to the estimated 150 warheads assigned to operational forces, production is thought to be under way for Shaheen-III and Ra'ad warheads to give a total estimated stockpile of 150–160 warheads.

Sources: Pakistani Ministry of Defence; various documents; US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, OH, July 2017); International Institute for Strategic Studies, *The Military Balance 2018* (Routledge: London, 2018); 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and authors' estimates.

has a declared range of 2750 km, making it the longest-range system to be tested by Pakistan to date.

Pakistan's National Defence Complex is developing a new MRBM, the nuclear-capable Ababeel, based on the Shaheen-III's airframe and solid-fuel motors.<sup>12</sup> On 24 January 2017 Pakistan announced that the first test launch of the Ababeel, aimed at 'validating various design and technical parameters of the weapon system', had been successfully carried out.<sup>13</sup> According to the armed forces' press service, the missile is 'capable of delivering multiple warheads, using Multiple Independent Re-entry Vehicle (MIRV) technology' and is being developed to '[ensure the] survivability of Pakistan's ballistic missiles in the growing regional Ballistic Missile Defence (BMD) environment'.<sup>14</sup> Pakistan's National Defence Complex is reportedly developing the technology to deploy MIRV-equipped missiles as a countermeasure to India's prospective ballistic missile defence system.<sup>15</sup>

Pakistan has prioritized the development of new nuclear-capable short-range missiles that appear to be intended for tactical nuclear roles and missions. In pursuing its 'full-spectrum deterrence' posture, Pakistan's defence planners have given particular attention to nuclear options for responding to an Indian military doctrine that envisages carrying out rapid but limited conventional attacks on Pakistani territory using forward-deployed forces.<sup>16</sup>

Pakistan has deployed two land-based, single-stage ballistic missiles that are reportedly capable of delivering compact, low-yield nuclear warheads

<sup>12</sup> The National Defence Complex (also referred to as the National Development Complex or National Development Centre) and its supervisory organization, the National Engineering and Scientific Commission (NESCOM), are the principal bodies responsible for Pakistan's missile development programmes. Nuclear Threat Initiative (NTI), 'National Defence Complex', updated 27 Sep. 2011.

<sup>13</sup> Pakistan Inter Services Public Relations, Press Release PR-34/2017-ISPR, 24 Jan. 2017.

<sup>14</sup> Pakistan Inter Services Public Relations (note 13); and Gady, F. S., 'Pakistan tests new ballistic missile capable of carrying multiple nuclear warheads', *The Diplomat*, 25 Jan. 2017.

<sup>15</sup> Tasleem, S., 'No Indian BMD for no Pakistani MIRVs', *Stimson Center, Off Ramps Initiative Paper*, 2 Oct. 2017.

<sup>16</sup> Ahmed, M., 'Pakistan's tactical nuclear weapons and their impact on stability', *Carnegie Endowment for International Peace, Regional Insight*, 30 June 2016; and Sankaran, J., 'Pakistan's battlefield nuclear policy: A risky solution to an exaggerated threat', *International Security*, vol. 39, no. 3 (winter 2014/15), pp. 118–51.

as well as conventional warheads: the 200-km range, road-mobile Abdali (Hatf-2) and the 60-km range, road-mobile Nasr (Hatf-9). The Nasr system was initially tested in 2011 using a single-tube launcher but has subsequently appeared with a mobile multi-tube launcher that can fire a four-missile salvo.<sup>17</sup> An improved 70-km range version was test launched on 5 July 2017.<sup>18</sup>

### Sea-based missiles

As part of its efforts to achieve a secure second-strike capability, Pakistan is seeking to create a nuclear triad by developing a sea-based nuclear force. On 29 March 2018 Pakistan announced that the second test launch of a Babur submarine-launched cruise missile (SLCM), designated the Babur-3, had been successfully carried out from ‘an underwater, dynamic platform’ deployed in the Indian Ocean.<sup>19</sup> The missile was said to be a sea-based variant of the Babur-2 ground-launched cruise missile (GLCM) and to have a range of 450 km. Video footage released by Pakistan of the first test launch, conducted in January 2017, confirmed that the Babur SLCM is designed to eject through submarine torpedo tubes instead of from a canisterized vertical launch system.<sup>20</sup> It will probably be deployed on the Pakistan Navy’s three diesel-electric Agosta class submarines, which are currently in service.<sup>21</sup> Pakistan has ordered eight air-independent propulsion-powered conventional submarines from China, the first of which is expected to be delivered in 2022.<sup>22</sup>

In 2012 Pakistan established a Naval Strategic Force Command as the ‘custodian of the nation’s second-strike capability’.<sup>23</sup> It is unclear whether the Pakistan Navy has developed a command and control infrastructure to manage a submarine-based nuclear force or custodial arrangements for nuclear warheads deployed on patrol.<sup>24</sup>

<sup>17</sup> Ansari, U., ‘Pakistan holds parade after 7-year break’, *Defense News*, 24 Mar. 2015; and Haroon, A., ‘Pakistan test fires Haft IX’, *Dispatch News Desk*, 26 Sep. 2014.

<sup>18</sup> Pakistan Inter Services Public Relations, Press Release PR-344/2017-ISPR, 5 July 2017.

<sup>19</sup> Pakistan Inter Services Public Relations, ‘Pakistan conducted another successful test fire of indigenously developed submarine launched cruise missile Babur having a range of 450 kms’, Press Release PR-125/2018-ISPR, 29 Mar. 2018.

<sup>20</sup> Taheran, S., ‘Pakistan advances sea leg of triad’, *Arms Control Today*, 1 June 2018.

<sup>21</sup> Panda, A. and Narang, V., ‘Pakistan tests new sub-launched nuclear-capable cruise missile. What now?’, *The Diplomat*, 10 Jan. 2017.

<sup>22</sup> Khan, B., ‘China confirms submarine sale to Pakistan’, *Quwa Defence News and Analysis Group*, 16 Oct. 2016.

<sup>23</sup> Iskander, R., *Murky Waters: Naval Nuclear Dynamics in the Indian Ocean* (Carnegie Endowment for International Peace: Washington, DC, Mar. 2015), p. 17.

<sup>24</sup> Panda and Narang (note 21).

## Ground- and air-launched cruise missiles

In addition to the sea-based Babur SLCM, Pakistan continues to develop two types of ground- and air-launched nuclear-capable cruise missiles as an integral part of its pursuit of a full-spectrum deterrence posture. The Babur-2, which the Pakistani military calls Babur Weapon System-1 (B), is an extended-range version of the Babur (Hatf-7) GLCM that incorporates stealth design features. It was first test launched in 2016. The Pakistan Army conducted a successful flight test on 14 April 2018.<sup>25</sup> The Ra'ad (Hatf-8) ALCM, which Pakistan claims can carry either conventional or nuclear warheads to a range of over 350 km, has been flight tested seven times since 2007, most recently on 19 January 2016.<sup>26</sup> Although the initial tests were conducted using a PAF Mirage III combat aircraft, some reports indicate that the missile may have been integrated with the JF-17 aircraft.<sup>27</sup> In 2017 Pakistan revealed an improved version, the Ra'ad-II ALCM, with a reported range of 550 km.<sup>28</sup>

<sup>25</sup> Pakistan Inter Services Public Relations, 'Pakistan today conducted a successful test of an enhanced range version of the indigenously developed Babur cruise missile', Press Release PR-142/2018-ISPR, 14 Apr. 2018.

<sup>26</sup> Pakistan Inter Services Public Relations, Press Release PR-16/2016-ISPR, 19 Jan. 2016.

<sup>27</sup> Fisher (note 9).

<sup>28</sup> Khan, B., 'Pakistan officially unveils extended range Ra'ad 2 air-launched cruise missile', Quwa Defence News and Analysis Group, 23 Mar. 2017.