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Pakistan's nuclear programme: a net assessment

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Pakistan may have about 100 nuclear weapons and about 200 ballistic missiles (partly for conventional use) and shows all signs of expanding its nuclear force. In the past decade, a robust set of institutions and procedures has been put into place, aimed at preventing the unauthorized use, theft or sale of nuclear weapons, materials, or technology. There is no doubt that the Pakistan military has been taking nuclear security very seriously – first and foremost because it is in its own interest – and does that in a very professional way. This analysis argues that the main risks today are not those of "weapons falling into the wrong hands" and even less an "Islamist takeover of the country". They are risks of deliberate use and perhaps partial loss of control of the nuclear complex in wartime; and low-level leaks of expertise or materials, or a radiological incident in peacetime. On the longer run, a weakening of State authority over the territory and a failure of governance, or of a radicalization of current policies towards the West, should not be discounted.

1 – CURRENT STATE AND DIRECTIONS OF THE PROGRAM

- **Origins and Evolution**[2]

The primary rationale for the Pakistani bomb was security. Islamabad's loss of East Pakistan in the 1971 war was a key motivation: Pakistan needed the Bomb to ensure its survival. This rationale was bolstered by the perceived inevitability of the Indian bomb after the 1974 test, and the lack of a credible security guarantee.

These circumstances have not significantly varied since then. Always worried about Indian conventional superiority, Pakistan considers nuclear weapons as a means to avoid a defeat on the battlefield. Islamabad does not believe that China would be ready to risk war to support Pakistan in case of hostilities in South Asia, and the rocky history of US-Pakistan relations has made it impossible for Islamabad to count on Washington.

An added benefit of the programme was the ability to protect Pakistani support for the Kashmir insurgency by neutralizing the risk of major conventional war. A misguided belief that Pakistan could extend military actions beyond the Line of Control led to the disastrous Kargil expedition of 1999.

There is also a political component in Pakistan's nuclear drive. Zulfiqar Ali Bhutto wanted Pakistan to "walk tall". Maintaining equality with India was a primary motivation. Being the first Muslim nation to be endowed with the Bomb was also a matter of pride, and to this day the programme remains popular in Islamist circles. This rationale has continued to exist after the 1977 coup that toppled Bhutto. In the late 1970s, "Pakistan's nuclear weapons programme became synonymous with national sovereignty and national prestige, even when it was run by the very military that had eliminated Pakistan's best-known populist politician."[3]

[2] For a comprehensive history of the Pakistani nuclear program up to 2007 see International Institute for Strategic Studies (IISS), Nuclear Black Markets: Pakistan, A. Q. Khan and the rise of proliferation networks, London, IISS, 2007, Chapter 1, to which this author contributed.

[3] Samina Ahmed, "Pakistan's Nuclear Weapons Programme. Turning Points and Nuclear Choices", International Security, vol. 23, n° 4 (Spring 1999), p. 185.

Pakistan reached the nuclear threshold somewhere between 1984 and 1987. The exact date is unclear and depends on whether one refers to the year enough HEU was produced, or the year when weaponization was achieved.[4] According to some testimonies the first assembly of a weapon took place during the crisis of 1989-1990, when the insurgency in Kashmir prompted India to contemplate limited strikes at training camps across the border.[5] However, this remains controvertible and General Musharraf claims that as late as 1999 Pakistan's nuclear capability "was not yet operational".[6]

- **Nuclear Complex**

Pakistan has a large civilian and military nuclear program. Its history is marked by the rivalry between the Pakistani Atomic Energy Commission (PAEC), the initial organization created to deal with the nuclear program (both civilian and military), and the Khan Research Laboratories (KRL), originally created solely for uranium enrichment but which became in the 1980s a true competitor to PAEC, as both became involved in weaponization and missile acquisition. This competition was probably deliberately encouraged by the Pakistani leadership but facilitated the development of the A. Q. Khan network.

In the years 1999-2001, a reorganization of the program took place. All military or dual-use nuclear activities are now controlled by the NCA (National Command Authority), and the Strategic Plans Division (SPD) (see below). A division of labour among laboratories has been defined. The National Engineering and Scientific Commission (NESCOM, created in 2001), oversees weapons systems development. It has authority on the National Development Complex (NDC, created in 1990 as an offshoot of PAEC), which is in charge of weaponization. PAEC is responsible for uranium mining and processing, as well as plutonium-related programs. It oversees the development of the Khushab complex of heavy-water moderated reactors and has authority on the known reprocessing facilities of Nilore and Chashma. KRL is in charge only of uranium enrichment per se, at the facilities of Kahuta and Gadwal.

These facilities are not safeguarded.[7] The Pakistani government admits that it would be difficult to separate installations dedicated to civilian use from those dedicated to military use.

- **Nuclear Policy, Doctrine and Planning**

Minimum Deterrence and Its Requirements

After the 1998 tests, doctrine and organization were redesigned. Prime Minister Nawaz Sharif announced a principle of "minimum credible deterrence" in May 1999.[8] Pakistan

[4] For details see IISS, op. cit.

[5] See for instance interview of general Naserullah Babar in Mary Ann Weaver, Pakistan: In the Shadow of Jihad and Afghanistan, New York: Farrar, Straus & Giroux, 2003, p. 206.

[6] Pervez Musharraf, In the Line of Fire, New-York : Free Press, 2006, p. 97.

[7] The three small research reactors (Nilore) and three power reactors (one in Karachi, two at Chashma) that Pakistan has built for civilian purposes are safeguarded.

[8] Remarks of the Prime Minister of Pakistan, Nawaz Sharif, on Nuclear Policies and the CTBT, National Defence College, 20 May 1999.

claims that it is against an open-ended arms race in South Asia and does not seek an arsenal equivalent to that of India.

The policy of credible minimum deterrence has been constantly reaffirmed since then.[9] It translates into four objectives: (1) deterrence of all forms of external aggression; (2) building to this effect an effective combination of conventional and strategic forces; (3) avoiding a pre-emptive strike through protection and the threat of nuclear retaliation; (4) stabilizing strategic deterrence in South Asia.[10]

After the 1998 tests, Islamabad adopted a long-term development plan for its nuclear force. It is now reportedly implementing its second 10-year plan (presumably covering the years 2010-2020).

Islamabad believes in the theory of deterrence of the strong by the weak: the possibility of a smaller country to deter a larger one through the threat of damage incommensurate with the stakes of the conflict. It aims at being able to inflict "unacceptable" or "unbearable" damage to India.[11] The difficulty of defining unacceptable damage is admitted by Pakistani planners: one quasi-official report states that "because of the difficulty in predicting unacceptable damage, overkill would by necessity be built into the response".[12]

The meaning of minimum deterrence has reportedly been precisely defined, though perhaps not in numbers. In fact, general Musharraf claimed in 2005 that it had reached this threshold; but this bold statement perhaps referred just to an initial capability to deliver a few weapons on Indian cities with some guarantee of success.[13] Islamabad insists that the level of minimum deterrence can change over time, in light of the evolution of the threat. There have been consistent official statements since 1998 that minimum deterrence "cannot be quantified in static numbers".[14]

Guaranteed unacceptable damage implies survivability even after a first strike by the adversary. The Pakistanis are likely to use as a planning assumption an Indian pre-emptive strike (coupled, in the future, with the deployment of missile defence by New Delhi). Pakistani concerns have been compounded by the US-India partnership. In 2006, the National Command Authority (NCA) stated that "in view of the fact that the [US-India] Agreement would enable India to produce significant quantities of fissile materials and nuclear weapons from un-safeguarded nuclear reactors, the NCA

[9] For instance in communiqués issued after meetings of the National Command Authority.

[10] Major General Mahmud Ali Durrani, Pakistan's Strategic Thinking and the Role of Nuclear Weapons, Cooperative Monitoring Center Occasional Paper, SAND 2004 3375P, Sandia National Laboratories, July 2004, p. 23.

[11] In 2002, Musharraf underlined Pakistan's ability to inflict "unbearable damage to the enemy" "Musharraf vows to 'unleash a storm' if India attacks", The News, 30 May 2002.

[12] See Durrani, op. cit., pp. 26-32.

[13] "And today, I have been very pleased to announce that we have crossed that minimum deterrence level." (Pervez Musharraf quoted in "Excerpt from report by Pakistan TV on 19 March", President of Pakistan website, 19 March 2005).

[14] Foreign Minister Abdul Sattar, Address to the "Pakistan Response to the Indian Nuclear Doctrine" Seminar, 25 November 1999 (text reproduced in Disarmament Diplomacy, Issue n° 41); Khalid Banuri (an SPD officer) quoted in Andrew Bast, "Pakistan's Nuclear Calculus", The Washington Quarterly, vol. 34, n° 4, Fall 2011, p. 78.

expressed firm resolve that our credible minimum deterrence requirements will be met".[15] Meanwhile, Pakistan will probably resort to concealment and mobility (*à la* China) to ensure the survival of its force.

As an example of the type of calculations that Pakistani planners may make to that effect, a former Strategic Plans Division (SPD) officer wrote that for a set of 10 possible targets, a country may need 68-70 warheads (without taking into account the risk of a pre-emptive strike).[16]

Even though the Pakistani military seems to base its planning on rational strategic calculations, domestic political factors will also inevitably affect nuclear policy decisions. No Pakistani leader can afford to appear weak vis-à-vis India.

A Low Nuclear Threshold?

Pakistan has consistently stated that its nuclear weapons are solely intended to deter military aggression. Officials stress that "the use of nuclear weapons as a war-fighting tool is not a contemplated doctrine in Pakistani strategic thinking."[17]

Though the SPD remains rather insulated from the rest of the armed forces, Pakistan has made efforts to think through its nuclear doctrine and to integrate the nuclear dimension into its defence strategy. In 2002, the SPD participated in a joint wargame at the National Defense College. Strategic force commanders are now invited to participate in the all-important Corps Commanders Conference.

Islamabad would use nuclear weapons in response to conventional attacks by India as a "last resort".[18] There have been consistent statements by Pakistani officials since 1987 about the nuclear threshold: if its "national integrity was threatened" (General Musharraf, 2000)[19]; "only if the very existence of Pakistan as a state is threatened" (General Kidwai, 2001).[20]

The circumstances that might warrant nuclear use were described by General Kidwai in late 2001[21]: (1) *The spatial threshold*. The penetration of Indian forces on a large scale would elicit a nuclear response. The threshold could be low (some 50-100 km perhaps) in Kashmir and in Punjab. (2) *The military threshold*. The destruction of a large part of

[15] "Pakistan satisfied with Nuclear Deterrence Capability. Expresses firm resolve to meet future challenges", Pakistan Government Press Release, 12 April 2006.

[16] See Naeem Salik, Minimum Deterrence and India Pakistan Nuclear Dialogue: Case Study on Pakistan, Landau Network – Centro Volta, March 2006, p. 14.

[17] Feroz Hassan Khan, Comparative Strategic Culture: The Case of Pakistan, Strategic Insights, Volume IV, Issue 10, October 2005.

[18] For instance Musharraf in 2000 ("Pakistan leader says he's trained for war but can talk peace", CNN.com, 19 January 2000) and in 2002 (Rory McCarthy & John Hooper, "Musharraf ready to use nuclear arms", The Guardian, 6 April 2002). See also Peter Lavoy, "Pakistan's Nuclear Doctrine", in Rafiq Dossani & Henry S. Rowen, Prospects for Peace in South Asia (Stanford: Stanford University Press, 2005), p. 281.

[19] Adrian Levy & Sumit Das Gupta, "Nuclear Alert Sounded in Pakistan", The Sunday Times, 30 May 1999.

[20] Nuclear Safety, Nuclear Stability and Nuclear Strategy in Pakistan : A Concise Report of a Visit by Landau Network-Centro Volta, January 2002.

[21] Nuclear Safety..., op. cit.; Andrew Koch & Christopher F. Foss, "Pakistan strengthens nuclear security", Jane's Defence Weekly, 9 October 2002.

Pakistani land or air forces could lead to a nuclear response if Islamabad believed that it was losing the cohesiveness of its defence and feared imminent defeat.[22] (3) *The economic threshold*. Economic strangulation refers primarily to a blockade of Karachi, but could also concern the stopping of the Indus water flow, or the capture of vital arteries such as the Indus and the Karakoram highway. (4) *The political threshold*. A destabilization of the country fomented by India could also be a nuclear threshold if Islamabad believed that the integrity of the country was at stake.[23]

Pakistani planners insist that these thresholds are indicative and should not be viewed in isolation one from another. They do not accept that they plan for an early use of nuclear weapons.[24]

A few statements have referred to other WMD, suggesting that the Pakistani deterrent may have a role in discouraging chemical or biological attacks.[25] However, Pakistan's policy is also in line with the negative security assurances given by nuclear-weapon states: it will not use or threaten to use nuclear weapons against non-nuclear countries.[26]

Pakistan also threatens nuclear retaliation in case of a preventive or pre-emptive strike. Pakistan told India in 1998 that an attack against its nuclear installations (which are the subject of a non-aggression agreement between the two countries) would elicit "swift and massive retaliation with unforeseen consequences".[27] More precisely, the policy is "deterrence of Pakistan's adversaries from attempting a counter-force strategy against its strategic assets by effectively securing the strategic assets and threatening nuclear retaliation should such an attempt be made".[28]

Towards Controlled Escalation?

Islamabad will certainly want to avoid an all-or-nothing strategy, to reserve forces for a second strike and ensure deterrence credibility. It has certainly developed limited options on Indian territory (for instance on a base close to the border) or on Indian forces advancing on its territory. A limited strike might be aimed at signalling resolve, "establish intra-war deterrence" (in the words of a SPD official[29]), and/or perhaps to force other countries to intervene. Being in a situation of perceived conventional inferiority vis-à-vis a mortal enemy, Pakistan's conception of nuclear planning is close

[22] SPD officials explicitly refer to the Army's mechanized forces, the Air Force's F-16s, and the Navy's Agosta submarines (personal source).

[23] According to some, these thresholds are as many messages to various Indian constituencies: the Army for the spatial threshold, the Army and Air Force for the military threshold, the Navy for the economic threshold, the Research & Analysis Wing (RAW) for the political threshold.

[24] Personal source.

[25] "We cannot be asked to give up the right to defend our country against any external threat emanating from conventional or weapons of mass destruction. Pakistan reserves the right to maintain the ability to deter aggression by conventional weapons or non-conventional means." Statement issued by the Permanent Representative of Pakistan to the United Nations in Response to the Security Council Resolution 1172, 6 June 1998.

[26] Durrani, op. cit., p. 23.

[27] "Pakistan warns in disarmament conference of massive retaliation if nuclear installations attacked", United Nations Information Service, Press Release DCF/335, 29 May 1998.

[28] Durrani, op. cit., p. 23.

[29] Personal source.

to NATO during the Cold war. Pakistani interest in Western concepts of nuclear escalation can be traced back to US military training and formation given in the late 1950s. (One observer notes that Pakistani policy-makers have "internalised the US Cold War literature on nuclear weapons far more than Indian strategic elites".[30]) Given the small size of its force, however, a more appropriate reference might be the French doctrine of a final warning followed if needed by unacceptable damage. Due to its lack of spatial depth, Pakistan "cannot afford the luxury of distinguishing between tactical and strategic, within a nuclear context".[31] Pakistani planners insist that all their nuclear weapons are of strategic nature. But an increasing arsenal will lead it towards a posture of controlled escalation.

Pakistani planning certainly focuses on counter-value targeting, due to the low number of warheads it is believed to have and the probably poor accuracy – despite Pakistani claims to the contrary – of most missiles currently in service. Musharraf said that Islamabad should have "enough missile capacity to reach anywhere in India and destroy a few cities, if required".[32] Pakistani analysts regularly mention about a dozen cities. It has been suggested that threatening large populations is justifiable in religious terms as a suitable way of employing "terror" in warfare.[33] Given the size of India, Pakistan could not destroy a large percentage of its population of industry; but targeting key cities and facilities might incur unacceptable economic and psychological costs.

It is also likely that as its nuclear force grows and evolves, Pakistan will diversify its set of potential targets, as other countries have done, and it may already have done so. In a discussion of the "pain threshold of the opponent", a former SPD official, identifies possible targets as "major population centres, industrial complexes, major military bases, and communication hubs".[34] A diversification of targets could also make the Pakistani deterrent more credible than a crude counter-cities strategy, given that any strike on India would involve massive casualties among its Muslim population.

A Force on Low Alert

Pakistani nuclear systems are widely assumed to be kept in a low alert form. In normal times, missiles may not mated with warheads. President Musharraf referred in 2003 to a "geographical separation" between them.[35] It is also possible that warheads are kept in a disassembled form in normal times.[36] However, the SPD insists it has never confirmed

[30] Christopher Clary, Thinking about Pakistan's Nuclear Security in Peacetime, Crisis and War, Institute for Defense Studies and Analyses, 2009, p. 32.

[31] Shireen Mazari, "From non-proliferation to nuclear stability: the case of South Asia", Defence Journal, March 2000.

[32] Pravin Sawhney, "How inevitable is an Asian 'missile race'?", Jane's Intelligence Review, January 2000.

[33] Stephen P. Cohen, The Idea of Pakistan, Washington, DC, The Brookings Institution, 2004, p. 119.

[34] Salik, op. cit., p. 14.

[35] Quoted in B. Muralidhar Reddy, "'No chance for accidental n-war with India'", The Hindu, 11 January 2003.

[36] According to a Defence Ministry spokesman, "the launch mechanism, the device and various other mechanisms" are kept at different places (NTI Global Security Newswire, "Pakistan Splits Nuclear Weapons Among Three Services", 10 August 2006). See also: Mark Thompson, "Does Pakistan's Taliban Surge Raise a Nuclear Threat?", Time, 24 April 2009; David E. Sanger, "So, What About Those Nukes?", New York Times, 11 November 2007; and George Perkovich (2001) quoted in. Zafar Iqbal Cheema, "Pakistan", in Hans Born et al., Governing the Bomb: Civilian Control and Democratic Accountability of Nuclear Weapons, SIPRI/Oxford University Press, 2010, p. 83.

such arrangements; general Kidwai (and other SPD officials) has stated that forces are not on a "hair trigger alert" but that "separation is more linked to time rather than space".[37] Also, a former SPD official has denied that the warheads were kept in disassembled form.[38]

The time required for putting weapons on launch readiness is uncertain. Kidwai said in 2002 assembly could be done "very quickly".[39] Some accounts suggest that it would only take "minutes", other refer to "hours".[40] A different assessment was offered by former Army Chief of Staff Mirza Aslam Beg; referring to assembly and mating he said that "there would be a gap of hours, or even days before [a weapon system] could be put together" (and weapon components are stored "many miles away" from delivery systems).[41]

Once made operational, the forces would have to contend with three possible scenarios: "launch on warning; launch under attack; launch on orders."[42]

- **Fissile Material and Warheads**

Pakistan began producing Highly Enriched Uranium (HEU) in the mid-1980s. As of 2011 it was believed to have produced 2-3.5 tons of HEU.[43] It is one of only two States (with India) known to produce HEU today. It may be producing 120-180 kg a year, enough for 10-15 warheads.[44] The Kahuta plant is believed to have a capacity of 15-45 tSWU/year.[45]

More recently, it has begun developing an important plutonium (Pu) production capability. At the Khushab site, two reactors are operating and two others are being built. New reprocessing facilities are also being constructed at Nilore (the current one having a capacity of 20-40 tHM/year) and probably at Chashma (with a capacity of 50-100 tHM/year), which hosts a never-completed plant of French origin.[46] As of 2011 Pakistan had stockpiled around 100-160 kilos of Pu.[47] Estimates of production at Khushab is difficult: the two reactors in service do not operate continuously and may

[37] Quoted in Landau Network Centro Volta, Security and Safety Issues about the Nuclear Complex: Pakistan's Standpoints, 2008.

[38] Naeem Salik, "Ignore Hersh", PakNationalists.com, 27 November 2009.

[39] Kidwai quoted in Nuclear Safety..., op. cit.

[40] Owen Bennett Jones, Pakistan: Eye of the Storm, Yale University Press, New Haven, 2003, p. 212; Robert Windrem, "Pakistan: 'The crazy soup'. Nuclear politics – and the 'Islamic Bomb'", NBC News, msnbc.com, 6 February 2004.

[41] Greg Myre, "US Wants to Advise Pakistan on Nukes", Associated Press, 3 November 2001 ; Jack Redden, "Ex-Army Head: Pakistan Had Nuclear Arsenal in 1989", Reuters, 26 June 2001.

[42] Feroz Hassan Khan, "Pakistan's Nuclear Force Posture", in Zachary S. Davis, The India-Pakistan Military Standoff: Crisis and Escalation in South Asia, London, Palgrave MacMillan, 2011, p. 135.

[43] 2,2-3,0 tons according SIPRI Yearbook 2011, 2011, p. 347; 1,75-3,75 tons according to International Panel on Fissile Materials (IPFM), Global Fissile Material Report 2011, 2012, p. 11.

[44] SIPRI Yearbook 2011, 2011, p. 347.

[45] IPFM, op. cit., p. 32.

[46] IPFM, op. cit., p. 33.

[47] 80-120 kilos according to SIPRI Yearbook 2011, op. cit., p. 347; 90-180 kilos according to IPFM, op. cit., p. 19.

not be of the same type.[48] Khushab-1 can produce 5,7-11,5 kilos of Pu/year depending on its duration of operation, enough for 1-3 warheads.[49]

Pakistan has increased its stockpile in recent years and probably has somewhere around 100 warheads.[50] Estimates remain uncertain since they are based on available information and assumptions regarding the number of launchers, the amount of fissile material produced, the amount of material actually converted into weapons cores, and the amount of material Pakistan uses in each weapon. Potential production of warheads per year today is 7 to 18.[51]

The tests carried out on May 28, 1998 were 5-20 (probably 8-12) kilotons HEU fission devices.[52] The Pakistanis claim that five devices were tested, but seismological data showed that the real number might have been two.[53] Questions also remain regarding the 3-11 (probably 4-6) kilotons May 30 test, conducted in a separate location and with a different setup. It may have been a plutonium or composite core. Open source analysis remains divided.[54] In 2006, Musharraf stated: "we do not have a plutonium weapon".[55]

Pakistan has several functional weapons designs. Two models were developed by PAEC for PAF aircraft, with reported yields of 2-10 kilotons and 10-20 kilotons.[56] Pakistan partly based its weapons designs on a 15-25 kiloton HEU implosion Chinese warhead, which can be carried by a missile.[57] (PAEC and KRL both worked on this design.[58]) Islamabad claims that no less than six different warheads types were successfully tested

[48] The second, third and fourth reactors may be larger models. However, IPFM (op. cit.) estimates that the four will have the same output.

[49] SIPRI Yearbook 2011, op. cit., p. 347. Same numbers in IPFM (op. cit.).

[50] Including 10-50 bombs according to Jane's Strategic Weapons Systems, Pakistan, Nuclear Bombs, 24 August 2011.

[51] 11-18 according to SIPRI data (see above); 7-14 according to David Albright, "Pakistan Doubling Rate of Making Nuclear Weapons: Time for Pakistan to Reverse Course", Institute for Science and International Security, 16 May 2011.

[52] Yield data from Brian Barker et al., "Monitoring Nuclear Tests", Science, vol. 281, 25 September 1998; and William R. Walter et al., Preliminary Regional Seismic Analysis of Nuclear Explosions and Earthquakes in Southwest Asia, Lawrence Livermore National Laboratory, 1999.

[53] A total of six shots meant one more than India did a few days earlier.

[54] Dana Priest, "US Labs at Odds on Whether Pakistani Blast Used Plutonium", The Washington Post, 17 January 1999; David E. Sanger & William J. Broad, "Pakistan May Have Aided North Korea A-Test", New-York Times, 27 February 2004.

[55] Agence France-Presse, "Musharraf says Pakistan didn't enable NKorea test", 12 October 2006.

[56] Jane's Strategic Weapons Systems, Pakistan, op. cit.

[57] Some claim that a Pakistani derivative of the Chinese warhead was tested in China in 1990, with a yield of 10-12 kilotons (Thomas C. Reed & Danny B. Stillman, The Nuclear Express: A Political History of the Bomb and Its Proliferation, Minneapolis, Zenith Press, 2009, p. 52). There is a debate on whether or not the Chinese-type warhead could be carried by Pakistani short-range missiles. Some claim that it is "much too big", others argue that it was made for Chinese M-11 and was thus suitable for its Pakistani version, the Ghaznavi. The Chinese warhead is allegedly less than one meter in diameter and weighs slightly less than 500 kilos. See WPS Sidhu, op. cit.; Andrew Koch, "Pakistan persists with nuclear procurement", Jane's Intelligence Review, vol. 9, n° 3, March 1997; Ibid., "Khanfessions of a proliferator", Jane's Defence Weekly, 3 March 2004.

[58] A handwritten comment on the design given to Libya says "Munir's bomb would be bigger", a probable reference to Munir Ahmad Khan, then-chairman of PAEC. William J. Broad & David E. Sanger, "As Nuclear Secrets Emerge in Khan Inquiry, More Are Suspected", New York Times, 26 December 2004.

in 1998.[59] This is certainly an exaggeration, but there is little doubt that the tests allowed Pakistan to refine its designs. Missiles are probably armed with low-yield warheads: tentative evaluations are warheads of 15-35 kiloton, 12-20 kiloton, and 1-5 kilotons for the short-range missiles (if endowed with nuclear weapons).[60] Inquiries of the Khan network uncovered the existence of two modern, sophisticated designs allowing for the making of warheads smaller and lighter – and also more powerful – than the Chinese one.[61]

Whether or not Pakistan already has a proven Pu-based implosion design, it is likely that it will continue to rely for long on HEU weapons.

- **Means of Delivery**

Pakistan initially relied on aircraft as delivery vehicles for its nuclear weapons and in the mid-1980s procured 40 F-16 aircraft from the United States that, when modified, could be used for that purpose. From 1985, passage of the Pressler Amendment made delivery of additional F-16 aircraft, as well as spare parts, dependent on US Presidential annual certification that Pakistan did not possess a nuclear explosive device. In 1990 the Pressler Amendment was finally invoked. By then, Pakistan had already begun to examine a ballistic missile alternative, prompted additionally by the development of India's own ballistic programmes.

Over the past 15 years, Islamabad has begun placing part of its deterrent on ballistic missiles (see below), dramatically increasing the probability of success of a strike on Indian territory. However, this capability remains limited. With a range of less than 1000 km, the Shaheen-1 and Ghaznavi are more theatre than strategic missiles (though they could reach some of India's cities if placed in the eastern part of Pakistan). The Ghauri's range is longer but it is liquid-fuelled, thus less reliable and more vulnerable. Thus planners refer to the solid-fuelled, long-range Shaheen-2 as the "mainstay" of the country's future deterrent.[62] If based in Punjab, it could reach the eastern cities of Kolkata, Bangalore and Chennai.

The limitations of Pakistani nuclear missile capability explain why Islamabad will continue to maintain an air-based component. In addition, the value of diversity in the force is well-known. Aircraft could for instance be used to target an Indian formation on Pakistani territory. Some also believe that multiplication of nuclear assets and bases make Pakistan a "target-rich" environment and lessens the possibility of a pre-emptive strike. To that effect, Pakistan equips some of its ground attack aircraft, probably part of its US F-16C/D force (one squadron) and Mirage-5 force (3 squadrons), with nuclear bombs.[63] It is not known whether the new JF-17 Chinese fighter, which equips one squadron of the Pakistani Air Force (PAF) since 2010, has a nuclear capability.

[59] Interview of Samar Mubarakmand, Chairman of NESCOM, Capital Talk Special, GEO-TV, 3 May 2004.

[60] Jane's Strategic Weapons Systems, Pakistan, op. cit.

[61] See Catherine Collins & Douglas Frantz, Fallout. The True Story of the CIA's Secret War on Nuclear Trafficking, New York, Free Press, 2011, p. 195, p. 201, p. 204.

[62] Personal source.

[63] The SIPRI Yearbook only lists the F16 as nuclear-capable.

- **Nuclear Command and Control**

Ever since Zia's death in 1988, the Pakistan's nuclear program had been managed by the Army. The decision-making apparatus was revamped after the tests and the 1999 coup. Musharraf instituted a National Security Council (NSC) comprising the 13 main civilian and military leaders.[64] A consolidation of nuclear C2 was announced by the NSC in February 2000, putting the programme for the first time under full military control and establishing accountability of the laboratories. The new structure became fully operational by 2002.[65]

The structure, sometimes referred to as the Strategic Command Organization (SCO), comprises three elements: the NCA, a Strategic Plans Division (SPD), and three Strategic Forces Commands (SFC) reporting to the NCA, in charge of "technical, training and administrative control". The Army's SFC is the most powerful since it is in charge of all missiles in service and is headed by a three-star general (as opposed to a two-star officer for the two other).[66] In November 2000, all organizations participating in the nuclear and missile programmes ("strategic organizations") were put under the control of the NCA: PAEC, KRL, NESCOM and the Space and Upper Atmosphere Research Commission (SUPARCO, created in 1981), which participated in the development of ballistic missiles and uses them as launch vehicles.[67]

The NCA is composed of the top civilian and military officials, and is meant to take all major decisions regarding nuclear and space policy. It meets two or three times a year.

The 2000 press release announcing the creation of the NCA stated that it would be chaired by the Head of the Government.[68] However, official Pakistani documents presented it as chaired by the President, with the Prime Minister as vice-chairman. This was due to the change in Musharraf's position, who became president only in 2001. The 18th amendment to the Constitution shifted power to the Prime Minister and made him the chairman of the NCA.[69] Prime Minister Gillani chaired his first meeting of the NCA in January 2010. The legal framework of the NCA was formalized through the NCA Act of March 2010 (retroactively in force since December 2007), and the turning into law of the 18th Amendment in April 2010.

The Foreign Minister is deputy chairman of the Employment Control Committee (ECC), which defines nuclear strategy and would decide on nuclear use. It includes the main ministers and the military chiefs. The Chairman of the Joint Chiefs of Staff – a symbolic position in Pakistan – is deputy chairman of the less important Development Control Committee (DCC), which is responsible for weapons development and oversight. It includes military and scientists, but no political leader. The planned

[64] Legal Framework Order 2002 (Chief Executive's Order n° 24 of 2002).

[65] Personal source.

[66] Personal source. The Army's SFO includes 12,000-15,000 personnel (IISS, The Military Balance 2012, p. 263).

[67] NESCOM is not mentioned in the NCA Act of 2010.

[68] Associated Press of Pakistan, "Pakistan Announcement of Nuclear-Weapon Command-and-Control Mechanism", 3 February 2000.

[69] A possible sign that the President is now outside the loop is Zardari's 2008 public statement that he would favour a no-first-use doctrine.

deliberative process for nuclear use is described by the SPD as being akin to that of a "board of directors".[70] The principle of unanimity was affirmed by the NCA in 2003.[71] A decision to use nuclear weapons would need "consensus within the NCA, with the chairman casting the final vote".[72] But if consensus was impossible, a majority vote would suffice.[73] Given that the ECC now comprises five civilians and four military *ex officio* members (not including the SPD head), it is not unreasonable to conclude that the military leadership would be the *de facto* decision-maker. However, it would probably ensure that the civilians shared the responsibility of the decision to use nuclear weapons.

The SPD, a 70-officer body, is the NCA's secretariat and has evolved into a true nuclear enclave in the Pakistani defence system.[74] It has been led since its inception by the same (now retired) Army officer, Khalid Ahmed Kidwai. This reflects both the service's dominant position in the armed forces (just like in China, Pakistan's number one ally) and the seriousness and the continuity of the Pakistani nuclear policy. The Division is also involved in the selection and training of students called upon to serve in the nuclear complex.

There is every reason to believe that Pakistan takes good care of its nuclear weapons. It sees them as the ultimate guarantee of it survival. And it knows that it cannot afford to make a mistake.

- **Outlook**

Towards a Continuous Expansion of the Nuclear Arsenal

The expansion and diversification of Pakistan's nuclear arsenal is highly likely in the coming decade. In late 2010, Islamabad had enough fissile material for at least 160 warheads, perhaps 240.[75] The coming online of the third and fourth Khushab reactors could bring the total Pakistani build-up capacity to 19-27 weapons a year.[76] Reprocessing facilities are being expanded (including the completion of the French-built plant). Pu weapons will represent an increasingly important share of the arsenal.

The expansion of the arsenal is partly instinctual, but Pakistan believes it also has sound rationales to go in that direction. Islamabad is probably not yet satisfied with its ability to inflict unacceptable damage on such a big country as India (especially with low-yield warheads). A larger arsenal will also protect Pakistan against the risk of a first strike (though only if coincidental with an increase in dispersal and diversification of sites). Pakistan is particularly worried that the rapid increased in Indian military spending, along with closer US-India nuclear and defence cooperation, will widen the

[70] Personal source.

[71] Zeb, op. cit., p. 396.

[72] Durrani, op. cit., p. 24.

[73] Kidwai cited in Pennington, op. cit.

[74] It is part of the Joint Staff, a weak institution in Pakistan, and its Director General (DGSPD) does not participate in the Corps Commanders Conference, arguably the apex of the Pakistani military system.

[75] Hans M. Kristensen & Robert S. Norris, "Pakistan's nuclear forces, 2011", Bulletin of the Atomic Scientists, vol. 67, n° 4.

[76] 19-26 according to Albright, op. cit.; 13-27 according to SIPRI Yearbook 2011, op. cit., p. 347.

conventional gap between the two countries and make India able to consider a conventional disarming strike on Pakistan's strategic assets.[77] (Some claim that the international momentum for a cut-off treaty also explains why Pakistan has increased the rate of conversion of its stockpile to weapons.[78]) Two developments could boost the expansion trend even further: the appearance of another, non-friendly nuclear-capable country at its borders (Iran), and the need for increased military commitment in the Western regions of Pakistan (Baluchistan, the Tribal Areas, and Khyber Pakhtunkhwa).

It would be logical for Pakistan to develop boosted fission weapons, and perhaps develop thermonuclear ones.[79] How much such designs would need to be tested depends on the level of assistance China has given and will give.

A 2004 quasi-official report stated that "Pakistan will work towards the development of a triad by giving the Pakistani Navy nuclear capability".[80] At that time, Pakistani planners did not refer to it as a priority.[81] The pace of the Pakistani program will depend on the scope of India's own effort (its first SSBN begins sea trials in 2012), on Pakistan's confidence in the survivability of its land-based missiles, on available resources and technical obstacles, and perhaps also on the Navy's ability to defend its own parochial interests. A Navy component could be surface- or undersea-based (the latter requiring an unlikely adaptation of the French-built Agosta-class diesel-electric submarines, or the acquisition of dedicated submarines to China). It would likely rely on Hatf-7 cruise missiles.

By 2020, Pakistan should have a large, seamless family of nuclear capabilities. As its potential grows, Islamabad is probably tempted to move away from minimum deterrence and have its doctrine evolve towards flexible response and escalation dominance (a temptation which could also be a factor behind the expansion of the stockpile). A major question is whether it will endow its forces with a large number of short-range nuclear missiles such as the Nasr (see below). According to one estimate, it could have, by 2020, some 200 warheads, and perhaps much more.[82] This assumes, however, that Islamabad will have the resources and capabilities to produce enough fissile material and warhead components.

Few Prospects for Constraints on Force Development

It is unlikely that Pakistan would be the first Asian nuclear-capable country to ratify the Comprehensive Test Ban Treaty (CTBT), unless Islamabad took the decision to do so after a final testing campaign – not unlike France in 1995. It is equally unlikely that

[77] Lavoy, op. cit., pp. 156-158.

[78] Yogesh Joshi, "Understanding Pakistan's Nuclear Rationale", Swiss Federal Institute of Technology Zürich, 26 may 2011.

[79] Pakistan claims to have tested boosted fission devices in 1998. According to a well-known Pakistani nuclear physicist, "there is little doubt that Pakistan is seeking to make [a thermonuclear weapon]." Pervez Hoodbhoy, "Pakistan's Nuclear Trajectory Past, Present and Future", in Pakistan: Reality, Denial, and the Complexity of its State, Heinrich Böll Stiftung, 2009, p. 123.

[80] Durrani, op. cit., p. 31.

[81] Personal source.

[82] Kristensen & Norris, op. cit.; Hans M. Kristensen, "Estimated Pakistani Nuclear Weapons And Fissile Materials" (chart), Federation of American Scientists Strategic Security Blog, 17 July 2011.

Pakistan will be the first to test again.[83] But if India were to test, Islamabad would probably seize the opportunity for technical reasons (enhancing reliability and security, testing new designs, for smaller warheads or new types such as boosted fission or thermonuclear ones) and political ones (settling the score again). There are thus three scenarios: (1) Pakistan resumes testing after an Indian testing campaign. CTBT ratification then becomes an option; (2) Pakistan resumes testing after a critical design flaw is detected in one of its warheads formulas (unless China was willing to assist); (3) Pakistan announces that it joins the CTBT after conducting a final testing campaign.

Pakistan has produced a large stockpile of fissile material but wants to avoid any regime that would give a perpetual edge to India. Therefore, its position is that three conditions should be met for Pakistan to join a cut-off treaty: (a) stocks reductions should be progressive, (b) transfers of stockpiles to civilian use should be organized in such a way that States with the largest ones lead the way in a verifiable fashion, and (c) caps on future stocks should reduce asymmetries in existing stocks. In addition, Pakistan worries that the US-India deal could free Delhi's production capability for military purposes, and is concerned by a growing military and technological gap between the two countries, leading it to increase its fissile material production. In any case, Pakistan could not participate in a cut-off treaty without India doing so as well, and in the process reducing any asymmetry. Meanwhile, it will continue to build-up its stockpile and delay the opening of negotiations for such a treaty.[84] However, Islamabad claims that if it was the recipient of a Nuclear Suppliers Group waiver (like India), it would be willing to enter the negotiation.

- **Ballistic and Cruise Missile Programs**

By the late 1980s, PAEC had begun to import Chinese missiles. A few years later, KRL approached North Korea on behalf of the Pakistani military. Islamabad needed longer-range missiles, and China was beginning to be pressed by Washington to limit its ballistic technology transfers. Pakistani authorities also probably saw an advantage in having two different missile families and another field of competition between the two laboratories.

PAEC introduced the Ghaznavi solid-fuelled missile (300-400 km) based on the Chinese M-11. KRL introduced the liquid-fuelled, single-stage Ghauri-1 (1,300 km) and -2 (1,800 km) based on the North Korean No-dong. NDC, created in 1990 as an offshoot of PAEC, developed the single-stage Shaheen-1 (450-750 km) based China's M-9. All these missiles were inducted in the Pakistani armed forces in 2003-2004. NDC then developed the two-stage Shaheen-2 (2,000-2,500 km), now entering service and slated to become the crown jewel of the Pakistani deterrent. As of 2012, Pakistan may have a total of less than 100 of those medium-range missiles.

Pakistan is also developing a large family of theater or battlefield-range missiles. In the 1980s, SUPARCO developed the Hatf-1 (80 km) and Hatf-1B (100 km), which could

[83] Pakistan stated in 2001 that it would not be the first to resume testing (Abdul Sattar, Address at the Carnegie International Non-proliferation Conference, Washington, 18 June 2001). This commitment was renewed several times since then.

[84] "In the time that we can, we need to enhance our own capabilities so that we have sufficient material for what we would then feel is a credible second-strike capability" ("The South Asian Nuclear Balance: An Interview With Pakistani Ambassador to the CD Zamir Akram", Arms Control Today, December 2011).

possibly be nuclear-armed, but are primarily slated for a conventional role. As of 2012, it had about 100 of those. This family is now being enlarged through the development of a shorter-range missile (Nasr, 60 km) and of a longer-range one (Abdali, 180 km). The first test of the Nasr in 2011 was troublesome, since it was advertized as nuclear-capable – which, for a 60 km-range missile, suggests more a tactical than a strategic role. However, Pakistan considers that all of its nuclear-armed missiles are of a strategic nature.

Partly in reaction to India's own programs, Islamabad began developing a few years ago two cruise missile programs, the Babur (ground-launched, with possibly other modes) and the longer-range Ra'ad (air-launched). Both are heralded as nuclear-capable.

There have been unconfirmed plans for a Ghauri-3 (3,500-4,000 km), which may have been cancelled in favor of a planned Shaheen-3 (4,000-4,500 km).[85]

Pakistan is not known to have exported its missiles or missile technology.

2 – RISK ASSESSMENT AND SCENARIOS

Concerns about Pakistani WMD are numerous and diverse. They can be broken down in three different categories partially overlapping each other: WMD-related transfers, loss of control of nuclear weapons, and deliberate nuclear use. Two sets of measures taken in the post-1998 context – with limited US assistance – are supposed to contribute to the prevention of the first two categories: Pakistan's reliability programs and various measures of physical security and surveillance.

TWO CATCH-ALL PREVENTIVE MEASURES

Screening programs

Pakistan has set up screening procedures to ensure the loyalty and mental balance of personnel serving in the most sensitive positions. These procedures were established in the early 2000s; it took two years to do so, and the reform had to overcome resistances.[86] Two different programs exist: a Human Reliability Program for civilians and a Personnel Reliability Program for military.[87] They have been applied to some 2,000-4,000 persons (numbers vary).[88] This includes about 2,000 scientists or engineers working in particularly sensitive areas or having critical knowledge; they continue to be monitored after retirement.[89] The SPD plans to extend these programs to all 10,000

[85] Usman Ansari, "Pakistan Pushes To Improve Missile Capability", Defense News, 17 November 2008; "Musharraf stopped funds for Ghauri-III saying 'Do you want to destroy Israel?'", The News, 28 May 2011.

[86] According to Kidwai cited in "Pakistan: CJCS Mullen Meets with General Kidwai on Safeguarding Nuclear Assets", US State Department diplomatic cable, 20 February 2008, [Wikileaks].

[87] Feroz Hassan Khan, "Nuclear Security in Pakistan: Separating Myth From Fiction", Arms Control Today, July-August 2009.

[88] Personal source.

[89] Matthew Pennington, "Pakistan: Nuclear Assets Safe, Outlines Nuclear Protocol", Associated Press, 26 January 2008 ; Jeffrey Goldberg & Marc Ambinder, "The Ally From Hell", The Atlantic, December 2011; David E. Sanger, The Inheritance: The World Obama Confronts and the Challenges to American Power, New

personnel having access to sensitive information.[90] The screening process can take up to a year.[91] It involves four different agencies: the Inter-Services Intelligence (ISI), the Intelligence Bureau, the Military Intelligence and the SPD.[92] There are clearance rechecks every two years.[93] Unsurprisingly, checks are said to focus on finances and religious beliefs.[94] Punjabis, who make up for two-thirds of Pakistani officers, are reportedly privileged over other origins.[95] There have been reports of attempts by militant groups to infiltrate the nuclear complex through Pakistani scientists trained abroad.[96]

Physical security and surveillance

Three levels of nuclear security exist. The first level (inner ring) is managed by the SPD, which controls some 9,000 personnel dedicated to this task.[97] The SPD's directorate in charge of nuclear security is led by a two-star general and is endowed with its own counter-intelligence team. It has a cell in each of the four laboratories controlled by the NCA, each headed by a one-star general. The second level is physical (fencing, sensors, etc.). The third level (outer ring) is surveillance and monitoring of suspicious activities around the site, with ISI involvement.[98] The SPD has a system of sensitive material control and accounting. It involves regular and surprise inspections. It has reportedly adopted inventory systems to track individual components of warheads.[99] Theft- and tamper-proof containers and vehicles are used for storage and transport.[100]

York, Harmony Books, 2009,., p. 212. In interviews and briefings, SPD officials give numbers of 7,000 to 10,000 nuclear scientists and engineers out of a total of 70,000 persons in the nuclear and missile complex.

[90] Security and Safety Issues..., op. cit.

[91] Peter Wonacott, "Inside Pakistan's Drive To Guard Its A-Bombs", Wall Street Journal, 29 November 2007.

[92] Rizwan Zeb, "David Versus Goliath? Pakistan's Nuclear Doctrine: Motivations, Principles and Future", Defense & Security Analysis, vol. 22, n° 4, December 2006, p. 396.

[93] Kenneth N. Luongo & Gen. (Ret.) Naeem Salik, "Building Confidence in Pakistan's Nuclear Security", Arms Control Today, December 2007. As examples of suspicious activities, Pakistani officials mention an employee dismissed from his job for distributing leaflets of a religious party and trying to persuade his colleagues to attend a rally (Naeem Salik, The Genesis of South Asia Deterrence. Pakistan's Perspective, Oxford, Oxford University Press, 2009, p. 285), or a scientist who had made a speech against the US and Musharraf at a mosque (Pennington, op. cit.).

[94] Wonacott, op. cit.

[95] Shaun Gregory, The Security of Nuclear Weapons in Pakistan, Brief n° 22, Pakistan Security Research Unit, 18 November 2007, p. 4.

[96] David E. Sanger, The Inheritance: The World Obama Confronts and the Challenges to American Power, New York, Harmony Books, 2009, pp. 178-179.

[97] SPD officials give numbers ranging from 8,000 to 10,000. A 2011 press report mentioned that over 8,000 new personnel would be trained by 2013 at the SPD nuclear security training academy (Rezaul H. Laskar, "Pak plans to train over 8,000 personnel to augment N-security", PTI, 19 October 2011). One informed report mentions two Army divisions, thus about 18,000 troops (Andrew Bast, "Pakistan's Nuclear Surge", Newsweek, 23-30 May 2011). The source was former President Musharraf in a 2011 on-the-record interview with the author. This number refers perhaps to the total of current and future force.

[98] Peter R. Lavoy, "Islamabad's Nuclear Posture: Its Premises and Implementation", in Sokolski, Pakistan's Nuclear Future, op. cit., p. 152.

[99] Farhan Bokhan & James Lamont, "Obama says Pakistan nukes in safe hands", Financial Times, 30 April 2009.

[100] Khan, « Nuclear Security in Pakistan… », op. cit.

The SPD has also set up a Special Response Force, presumably to deal with nuclear incidents.[101]

A nuclear security review was conducted in 2011.[102] Washington has helped Pakistan refine such measures through the sharing of expertise and perhaps equipment.[103]

On the civilian side, the Pakistan Nuclear Regulatory Authority (PNRA) created in 2001, which includes 200 experts, is in charge of physical security of fissile material and radioactive sources. The military is strongly involved and the DGSPD is a member of the PNRA. A five-year Nuclear Security Action Plan, designed to enhance safety and security of nuclear materials and radioactive sources, was adopted by the PNRA in 2006. Special border controls have been set up.[104] A safety review of existing and planned facilities was conducted in 2011.[105] All known sources are said to have been registered, orphan sources have been recovered, two secure storage sites have been set up.[106] Pakistan cooperates with the IAEA to improve nuclear safety.[107] Islamabad ratified the Convention on the Physical Protection of Nuclear Materials (CPPNM) in 2000.[108] It participates in the Global Initiative to Combat Terrorism. However, Pakistan has not ratified the 2005 amendment to the CPPNM and is not a party to the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT). A 2008 expert assessment judged that the control of the Pakistani civilian complex was satisfying.[109]

- **Concerns about WMD Materials, Technology and Expertise**

The first category of possible risks involves the export of WMD materials or expertise by the Pakistani authorities, or the transfer of such materials or expertise to a foreign State or to a non-State actor (be it for domestic or foreign use).

[101] Inter-Services Public Relations, Communiqué PR29/2012, 27 February 2012.

[102] Inter-Services Public Relations, Communiqué PR166/2011, 14 July 2011.

[103] In 1995, the Washington-based Henry L. Stimson Center began hosting officers later called to serve in the SPD (Testimony of Michael Krepon before the Senate Committee on Homeland Security and Governmental Affairs, "Addressing the US-Pakistan Strategic Relationship, 12 June 2008). An in-depth dialogue with Pakistan on nuclear matters began after the 1998 tests. Concrete US help almost certainly has not gone beyond generic assistance and training in the realms of psychological evaluation, perimeter surveillance, etc. Direct assistance to weapon-related security would run counter to the Non-Proliferation Treaty (NPT) and US law, and would be refused by Pakistan who fears that foreign countries would thereby gain intelligence as to its program. Since 2001, Washington has reportedly spent about 100 million USD (a figure disputed by Pakistani officials) on nuclear assistance to Pakistan. Roughly 200 Pakistanis have been trained at the US Sandia National Laboratories (Sanger, The Inheritance, op. cit., p. 223). Washington has also helped the SPD to create its nuclear security training academy.

[104] Luongo & Salik, op. cit.

[105] Inter-Services Public Relations, Communiqué PR166/2011, 14 July 2011.

[106] Security and Safety Issues..., op. cit.

[107] In 2006, the Stimson Center began hosting fellows from the PNRA (Testimony of Michael Krepon, op. cit.).

[108] Pakistan is also a party to the 1994 International Convention on Nuclear Safety.

[109] Security and Safety Issues..., op. cit.

State-Sanctioned Exports: A Thing of the Past?

For more than a decade now, there has not been any publicly known deliberate, State-approved transfer of WMD-related technology to foreign actors.

There is little risk of a sudden radical change Pakistani policy in this regard. Concerns about the political future of Pakistan are legitimate: throughout its short history, a majority of its leaders did not finish his or her normal term. But analysts agree that the risk of an Islamist coup does not exist. Islamist political forces are weak and divided; they do not fare well in elections. As a US researcher concluded in 2010, "The fortunes of the religious parties in the political space will continue to wax and wane, but not approach anything like a takeover of the government, much less the state". He also concluded that "speculation of a Taliban takeover dramatically overestimates the willingness of the political and military elites to surrender power to the Taliban."[110] Indeed, public attitudes towards the Taliban has shifted in recent years. On the military side, there is no organized radical Islamist entity within the armed forces. Even when soldiers or officers have Islamist sympathies – many of them are members of the Jamaat-I-Islami – their primary loyalties generally lay with the military as an institution. As an astute observer of the Pakistani military puts it, "the army remains a conservative institution at heart, it is not yet a breeding ground for large number of radical Islamists".[111] The only known military coup attempt which had Islamist support, in 1995, failed miserably. As a seasoned observer of Pakistani issues puts it, no analyst has presented any "convincing narrative" of how the country could be taken over by radicals.[112]

However, on the long run, a change in Islamabad's policy preferences, along with a degradation of the relations with the United States and its allies, could lead it to different deliberate strategic choices.

THE SAUDI SCENARIO: HOW CREDIBLE?[113]

In the past 15 years, analysts have speculated about the possibility of a Pakistani option should Saudi Arabia decide to replace its old fleet of CSS-2 missiles or have its own nuclear deterrent. Several variants of this scenario are possible: (1) A Pakistani nuclear guarantee to Saudi Arabia; (2) A stationing of Pakistani missiles on Saudi soil; (3) The sale of Pakistani missiles to Riyadh; (4) The stationing of nuclear-armed aircraft or missiles on Saudi soil (without relinquishing control of the warheads); (5) The sale of Pakistani missiles armed with nuclear weapons to Saudi Arabia. The first of these variants is highly credible, but the fifth one is highly incredible. A former SPD official

[110] Jonathan Paris, Prospects for Pakistan, The Legatum Institute, January 2010, p. 28.

[111] Shuja Nawaz, Crossed Swords: Pakistan, Its Army, and the Wars Within, Oxford, Oxford University Press, 2008, p. 585.

[112] Clary, op. cit., p. 28.

[113] See Bruno Tertrais, Le Marché noir de la Bombe. Enquête sur la prolifération nucléaire, Paris, Buchet-Chastel, 2009, and Bruce Riedel, « Enduring Allies », Force, December 2011.

referred in 2005 to the deployment of Pakistani warheads on Saudi soil as "worse than the Cuban missile crisis".[114]

While there is no hard evidence of nuclear cooperation between the two countries in the public domain, it would be surprising if Riyadh and Islamabad never discussed such scenarios. The two countries have a deep and longstanding relationship, including in the military domain, and Pakistani benefitted from indirect Saudi assistance to sustain the cost of its nuclear program.

The Possibility of Uncontrolled Leaks

Measures taken to prevent the transfer of WMD-related expertise and materials include first and foremost reliability programs as well as physical security and surveillance.

In 1999, the Pakistani Commerce Division issued a statutory regulatory order to control the export of nuclear technology. It implicated PAEC in the vetting of travel by officials linked with the nuclear programme. This did not prevent KRL from advertising, in 2000, the sale of nuclear technology in newspapers, and AQ Khan from continuing its activities. Only after the scandal erupted in 2003-2004 did Pakistan become serious on exports controls. An Export Control Act on Goods, Technologies, Material and Equipment related to Nuclear and Biological Weapons and their Delivery Systems was adopted in September 2004. Controlled items – for which a list was issued in 2005 – include those on various nuclear and biological multilateral exports controls regimes, and legislation includes a catch-all clause. In 2006, a Strategic Exports Control Division (SECDIV), headed by the Foreign Minister, was created. A revised control list was notified in 2011.

Fissile materials are likely to be stored near installations such as Kahuta or Khushab which are located in Punjab, the part of Pakistan best controlled by the military.

As in any country – but perhaps more in Pakistan than elsewhere – one cannot guarantee that the measures summarized above are foolproof. A limited transfer of knowledge will remain a possibility.[115] Given in particular the ambitions of Pakistan's civilian nuclear program, any breakdown of law and order in the future could facilitate the theft of radiological sources or various non-fissile nuclear materials. A weakening of State cohesion would also make the scenario of very small quantities of fissile material being gradually stolen at bulk processing facilities a real possibility.[116]

Pakistan has been ranked 31st out of 32 in a list of States with the best security of weapon-usable nuclear materials. Reasons given include the continued production of materials, political instability and corruption, the presence of non-State actors willing to seize materials, the non-ratification of several international agreements, and the fact that "Pakistani government statements about the security of the arsenal do not necessarily address the nuclear materials security conditions for materials that may be in bulk-processing facilities, in transit, or in storage."[117] However, India fares 28th.

[114] Personal source.

[115] A precedent is the fireside chat that two former nuclear scientists had with Al-Qaeda in Afghanistan in 2001.

[116] This scenario is a "major concern" to the US government according to "Scenesetter for Special Envoy Holbrooke", US State Department diplomatic cable, 4 February 2009 [Wikileaks].

[117] Nuclear Threat Initiative, Nuclear Materials Security Index, January 2012.

The Risk of Radiological Attack

A related risk is an attack designed to release large amounts of radioactivity, during the transportation of nuclear material (spent nuclear fuel or radioactive sources). About 50 public and private firms handle sources of greatest concern. However, only 6% these sources fall under IAEA categories 1 and 2. Pakistanis seem well aware of the possible risks.[118] PNRA experts regard the radiological attack scenario as "very remote probability bordering near impossibility".[119] The fear of a dirty bomb drove the US government to attempt, without success, the repatriation of the spent fuel from the Nilore research reactor, which until 1990 operated on HEU provided by Washington in the 1960s.

- **Concerns About Loss of Control of Nuclear Weapons**

The second category of risks involves loss of control of nuclear weapons to a terrorist group or a military rogue unit. Here also, preventive measures include reliability programs, and physical security and surveillance.

As stated, the weapons may be kept in a disassembled form. There is considerable uncertainty about the location of Pakistani nuclear weapons, in line with what Pakistan calls a policy of "Strategic Ambiguity". Some suggest that even the director of the ISI does not know where the weapons are.[120] It would make sense for most of them to be located in the northern and central parts of the territory, in the safest and more secure Punjabi parts of Pakistan.[121] After September 11, Islamabad ordered a redeployment of its arsenal (to at least six secret new locations according to one account), for fear of an Indian attack.[122] Likewise after the US May 2011 raid on Abottabad – this time by fear of a US raid.[123] Pakistan plays some form of shell game with its nuclear weapons. Dummy locations reportedly exist.[124] If the country has about 100 warheads, it would be surprising if sites hosting weapons at any given time numbered more than ten.[125] Some

[118] Luongo & Salik, op. cit.

[119] Abdul Mannan, "Preventing Nuclear Terrorism in Pakistan: Sabotage of a Spent Fuel Cask or a Commercial Irradiation Source in Transport", in Henry D. Sokolski (ed.), Pakistan's Nuclear Future: Worries Beyond War, Carlisle, Strategic Studies Institute, 2008, p. 267.

[120] The ISI director is not a member of the NCA. However, he is regularly invited to meetings (Peter R. Lavoy, "Islamabad's Nuclear Posture...", op. cit, p. 152).

[121] According to a former Pakistani official, "they're all in Punjab" (personal source).

[122] Molly Moore & Kamran Khan, "Pakistan Moves Nuclear Arsenal And Tightens Control Over Arms", International Herald Tribune, 12 November 2001. The move was confirmed by the DGSPD (Koch & Foss, op. cit.).

[123] The authors of the 2011 memorandum to the US government (see below) wrote: "One of the greatest fears of the military-intelligence establishment is that with your stealth abilities to enter and exit Pakistani airspace at will, Pakistan's nuclear assets are now legitimate targets". "Confidential Memorandum – Briefing for Adm. Mike Mullen, Chairman, Joint Chiefs of Staff", undated (Foreign Policy website, 17 November 2011).

[124] Goldberg & Ambinder, op. cit.; and Feroz Hassan Khan cited in Thomas E. Ricks, "Calculating the Risks in Pakistan", Washington Post, 2 December 2007.

[125] When splitting their arsenal among different bases, nuclear-capable States have to balance various operational, logistical, security and costs constraints. Assuming no less than 10 nuclear warheads per site would be a good compromise.

of them are subterranean.[126] Always worried to the point of paranoia about an Indian strike or a US raid, Pakistan has certainly gone to great lengths to physically protect its nuclear sites.

An attack against a nuclear base would need to confound SPD and ISI surveillance, then break the physical and military barriers that would preclude access to a nuclear weapon. Insider complicity would have to defeat the reliability programs. Military involvement inside or outside would need a breakdown in the culture of loyalty inherent to the Pakistani armed forces. If Pakistan has a ten storage sites, it presumably has several hundred available personnel, perhaps thousands, available to protect each of them. Also, access to a warhead supposes that attackers were able to secure both the fissile core and the warhead itself.

The initial security arrangements were primarily designed "with India in mind".[127] But the SPD began in 2008 to seriously address the threat posed by potential suicide bombers, instituting "new protocols".[128]

The terrorist attacks that have taken place in recent years against key military facilities can hardly be considered as precedents.[129] A potential danger is an attack designed to show the weakness of the State or create tensions in the country (or with India).[130] But it would not lead to access to warheads. Even the sophisticated October 2009 attack of the General Headquarters in Rawalpindi by the Tehrik-e-Taliban Pakistan pales in comparison with what would be needed to gain such access. And even the penetration of the outside perimeter of a large base hosting nuclear weapons does not mean that the intruders are able to get anywhere near a nuclear weapon.[131]

Intention is also debatable: radical Islamists are generally proud of Pakistan's nuclear capability and have so far shown little interest in attacking the country's nuclear infrastructure.[132] On jihadist forums, one can sometimes find discussions of attacks against nuclear facilities, but protecting assets from US seizure in case of a hypothetical Taliban takeover of the country seems at least important a priority.[133] Only avowed

[126] According to Musharraf cited in Seymour M. Hersh, "Defending the Arsenal", The New Yorker, 16 November 2009.

[127] Cheema, op. cit., p. 207.

[128] According to Kidwai cited in "Pakistan: CJCS Mullen Meets with General Kidwai on Safeguarding Nuclear Assets", op. cit.

[129] For details on past attacks see Charles P. Blair, Anatomizing Non-State Threats to Pakistan's Nuclear Infrastructure: The Pakistani Neo-Taliban, Federation of American Scientists, June 2011.

[130] Charles P. Blair, "Fatwas for fission: Assessing the terrorist threat to Pakistan's nuclear assets", Bulletin of the Atomic Scientists, vol. 67, n° 6, p. 28.

[131] A comparison can be made, all things equal, with the intrusion of activists on NATO nuclear bases, such as Kleine Brogel (Belgium) in 2010. Moreover, it is not an unfounded assumption to suggest that Pakistani military security is better than its Belgian equivalent.

[132] See for instance Matthew Rosenberg & Owais Tohid, "Taliban Say They Won't Hit Nuclear Arsenal", Wall Street Journal, 26 May 2011.

[133] Abdul Hameed Bakier, "Jihadis Discuss Plans to Seize Pakistan's Nuclear Arsenal", Terrorism Monitor, 26 May 2009.

adversaries of the regime mention their interest in having access to Pakistan's weapons after they take control of the State.[134]

Even if a non-State actor or a rogue military unit was able to take control of a nuclear warhead, it would still need to transport it – including perhaps to take it out of the country – while continuing to defeat the Army's defenses. The alternative would be detonation onsite; a rapid launch would require access to a mated missile (though suicide detonation could be an option).

The last line of defence is coding. Coding is now done during the manufacturing process, and the launch officer would receive the code a few moments before use and insert it via a computer.[135] (For aircraft, pilots would receive the full code during flight.[136]) It has been surmised that the codes are generated by the Military Intelligence (MI).[137]

Codes used are 12-digit alphanumerical.[138] A two-man rule operates. Codes are physically present on bases, split between two officers.[139] (One source has referred to a system of two separate codes, one of them civilian and the other military, but this appears dubious.[140]) There are both enabling and authenticating codes.[141] These arrangements are supplemented by "a tightly controlled ID system".[142] There is no involvement of intelligence services in the chain of command.[143]

At some points of the chain of command, a three-man rule operates "for technical reasons" according to the SPD.[144] One informed source (which mentions a "2-3 man rule") claims that the arming code is divided between three persons.[145]

Gauging the possibility of unauthorized use depends on the exact nature of the codes used by the Pakistanis. Are the arming mechanisms buried deep in the warhead design, or can coding be bypassed? Do they include disabling features? Is there a code for each warhead or set of warheads, or just a general nuclear release enabling mechanism? Does arming physically depend on a code transmitted down the chain of command at the last minute, or would the code(s) already present at the base be enough?

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[134] Bill Roggio, "Taliban commander wants Pakistan's nukes, global Islamic caliphate", The Long War Journal, 20 March 2012.

[135] Interview of Samar Mubarakmand, op. cit. Mubarakmand was a key architect of the nuclear program. The first Pakistani warheads were not fitted with such mechanisms (Luongo & Salik, op. cit.).

[136] Durrani, op. cit., p. 33.

[137] Gregory, "The Security...", op. cit., p. 4.

[138] According to Kidwai cited in Ron Moreau, "Pakistan's Nukes", Newsweek, 26 January 2008.

[139] Durrani, op. cit. p. 33.

[140] Bennett Jones, op. cit., p. 209.

[141] According to Kidwai cited in Gregory, The Security..., op. cit., p. 4. See also in Goldberg & Ambinder, op. cit.

[142] Gregory, The Security…, op. cit., p. 3.

[143] Shaun Gregory, « Nuclear Command and Control in Pakistan », Defence & Security Analysis, vol. 23, n° 3, September 2007, p. 319.

[144] Personal source.

[145] Durrani, op. cit., p. 24, p. 33.

The NCA authorizes each step of the process leading to nuclear use. According to the SPD, "no delegation of authority concerning nuclear weapons is planned".[146]

Devolution procedures have been set up to ensure continuous control of the arsenal in case the leadership was incapacitated (or decapitated in wartime). The Prime minister can delegate his NCA powers to the Chairman of the Joint Chiefs of Staff Committee (and not to the head of the Army, the most powerful military officer in the country).[147] Deputy chairs of the ECC and DCC have the authority to replace the Prime minister if he is unavailable or debilitated.[148]

It is noteworthy that control of nuclear weapons has survived an abrupt change in leadership (1988), a military coup (1999), and a major constitutional change (2010). And instability in Pakistan has not been dramatically higher than in other nuclear-capable States: witness China with the Cultural Revolution of 1966-1976; the Soviet Union with the 1991 attempted coup and breakdown of the country, and the 1993 crisis; or France with the 1958 regime change and the 1961 attempted coup. There is no reason to believe that, for instance, the command and control arrangements could not survive another military coup.[149]

The Pakistani context however calls for caution. One respected US expert worries that the country is "losing its coherence as a State".[150] On the longer run, the legal and institutional barriers that have been put into place to protect the arsenal could erode. A weakening of the State and an increased sympathy for radical militants within the armed forces or the nuclear establishment would make for a dangerous combination.[151] The conservative "Zia Generation", which joined the military in the 1970s and 1980s, will soon reach the highest echelons of the armed forces. If the Army was stretched thin due to grave domestic unrest and tensions with India, the control of the nuclear complex could suffer. Finally, how the SPD, currently rather insulated from the rest of the military and endowed with a rather benign view of the United States, will transition to the post-Kidwai era is also open to question.[152]

Most importantly, no one can guarantee that the robust set of procedures and controls that secure the arsenal would resist the extraordinary pressures of a nuclear crisis, and the fog of war during a conflict with India. Some also fear that a well-organized non-State actor could deliberately create a domestic or an international crisis to trigger the

[146] Quoted in Nuclear Safety..., op. cit.; see also Cheema, op. cit., p. 208.

[147] NCA Act of 2010.

[148] Cheema, op. cit., p. 204.

[149] The "memogate" (a 2011 scandal involving backchannel communications between parts of the civilian government and the US government) suggested differences of appreciation between the military and part of the civilian leadership about the current nuclear security arrangements. See "Confidential Memorandum", op. cit.

[150] Stephen Cohen quoted in Goldberg & Ambinder, op. cit.

[151] Pervez Hoodbhoy, a well-known Pakistani nuclear physicist, notes that students in his department at Quaid-i-Azam University (a recruitment pool for the nuclear complex) have become increasingly conservative. Wonacott, op. cit.; Ben Arnoldy, "Could Taliban get keys to Pakistan's A-bomb?", Christian Science Monitor, 15 May 2009.

[152] Kidwai – who like many Pakistani officers of his generation was partly trained in the United States – has won unanimous praise from Western security establishments. His biography is recounted in Sanger, The Inheritance, op. cit., pp. 195-200.

movement of warheads and attempt to capture some of them. Any such movement, for operational or security reasons, creates vulnerabilities. A precaution such as their transport in non-descript convoys – reportedly used by Pakistan – could backfire if used in crisis time, since such convoys are inherently less well-guarded than military ones.[153] A dispersal of warheads – to diminish the risk of a first strike or capture, or distribute them to launch sites – might increase the risk of a loss of control. And the development of a tactical nuclear capability might lead to a change in the Pakistani posture, with permanent mating and at least partial predelegation.[154] (Likewise, if Islamabad developed more elaborate and miniaturized designs, separation of the core and the rest of the warhead might become impossible.) Pakistan faces classic dilemmas: survivability and readiness call for dispersion, movement and predelegation; but security and secrecy call for concentration, no movement and code retention.[155]

Another question worth raising is the following: how would the system resist to a rift within the NCA in wartime, with for instance the Prime Minister opposing the use of nuclear weapons (and possibly going public about it)?

- **Concerns About Deliberate Nuclear Use**

In the end, the most important Pakistani nuclear risk today, in relative terms, is that of a deliberate nuclear use.

The induction of nuclear weapons in South Asia has had mixed consequences. Since 1998, there has been no major conventional war in the region. But the propensity for risk-taking remains high. Islamabad risked war in 1999, wrongly believing that India would be deterred from reacting. Both countries went to the brink of war in the winter of 2001-2002. Delhi was close to retaliate against Pakistan after the 2008 Mumbai attack.

India has attempted to checkmate Pakistan and block the avenues it thought it might open with its nuclear capability. The 1999 incident led to Delhi stating that it would not hesitate in waging a limited war. The 2001-2002 crisis led to the adoption in 2004 of the Cold Start doctrine – a fast campaign with limited objectives – capturing territory up to 50-80 km – but without months of mobilization, leaving no time to Pakistan or the international community to react. (A possible parallel is the Soviet Operational Maneuver Groups of the Cold War.)

The stability/instability paradox seems appropriate to characterize the strategic situation in the region. The probability that an incident degenerates into full-scale war is not trivial. A "second Mumbai" could be enough to trigger such a confrontation.

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[153] The use of "civilian-style vehicles" was reported in Goldberg & Ambinder, op. cit. Note that weapons would probably be encased in tamper-proof containers.

[154] A former SPD official admitted as much in 2005 when writing that "partial pre-delegation" would be an "operational necessity because dispersed nuclear forces as well as central command authority (..) are vulnerable". Feroz Hassan Khan, "Nuclear Command and Control in South Asia During Peace, Crisis and War", Contemporary South Asia, vol. 14, n° 2, June 2005, pp. 168-169.

[155] Some claim that the expansion of the Pakistani arsenal will create additional vulnerabilities. This would be true if there was a corresponding increase in the number of nuclear bases, which might not be needed (and Islamabad presumably has a higher number of vaults than warheads in order to move them).

If war was to erupt, the nuclear question might be raised after just a few days of fighting – as might have been the case for NATO against the Soviet Union. India has sought to foreclose any non-conventional option that Pakistan could have. In 2003, it warned Islamabad that it would not feel bound by its no first use posture in case of the use of CW or BW. It has informed Islamabad that any detonation of a weapon of Pakistani origin on Indian soil would be treated as intentional even if the Pakistanis claimed they had no responsibility.[156]

In 2003, Delhi made it known that it would use nuclear weapons in response to *any* use of such weapons against it, even on Indian forces operating on Pakistani territory. But it is far from certain that it would deter Pakistan from crossing the threshold if it felt compelled to do so to ensure its survival. Islamabad, in turn, now implicitly threatens to develop a tactical nuclear capability to block a sudden invasion of its territory. Despite its no-first-use doctrine, Delhi could react by considering preemptive options – just as Moscow did during the Cold war to counter a NATO first use.

In sum, the risk is that a combination of nationalist passions, self-confidence on each side, misunderstandings (compounded by the fact that both leaderships *believe* they understand each other), and miscommunications (despite the existence of dedicated channels, which are not used in crisis time) would turn a small-scale crisis into nuclear war.

[156] Personal source.

ANALYTICAL SUMMARY OF NUCLEAR RISKS AND PREVENTIVE MEASURES

	Screening programs	Separation of cores / war heads/launchers	Codes	Physical security and surveillance	Exports controls
State-sanctioned export of WMD	-	-	-	-	-
Transfer of WMD expertise	X	-	-	X	-
Theft of WMD materials	X	-	-	X	-
Export of WMD materials	X	-	-	X	X
Capture of a nuclear weapon	X	X	-	X	-
Unauthorized use of a nuclear weapon	X	X	X	X	-
Deliberate use of a nuclear weapon	-	-	-	-	-

PAKISTANI MISSILES: TECHNICAL AND OPERATIONAL DETAILS[157]

NAME	DESIGNATION	TYPE	PROPELLANT	RANGE	PAYLOAD	ACCURACY	IN SERVICE DATE	NUMBER
Nasr	Hatf-9	Single-stage	Solid	60 km			2014?	
Ra'ad	Hatf-8	Cruise (air-launched)	Solid/ turbojet	350 km			2013?	
Babur	Hatf-7	Cruise (ground-launched[158])	Solid/ turbojet	500-700 km	300 kg		2012?	
Shaheen-2[159]	Hatf-6	Two-stage	Solid	Initially 2000 km, now probably 2500 km	700-1000 kg	350 m	~2010?	
Ghauri-2	Hatf-5	Single-stage	Liquid	1800 km	700-1000 kg	2500 m	2003	25-50
Ghauri-1 [= No-Dong/DPRK]	Hatf-5	Single-stage	Liquid	1300 km	700-1000 kg	2500 m	2003	
Shaheen-1 [= M-9/China]	Hatf-4	Single-stage	Solid	Initially 450 km, now probably 700-750 km	700-1000 kg	200 m? (90 m if terminal guidance?)	2003	
Ghaznavi [= M-11/China]	Hatf-3	Single-stage	Solid	Initially 290 km, now probably 350-400 km	500-700 kg	250 m? (50 m if terminal guidance?)	2004	50
Abdali	Hatf-2	Single-stage	Solid	180 km	250-450 kg	150 m? (30 m if terminal guidance?)	2012?	
Hatf-1A/1B	Hatf-1A/1B	Single-stage	Solid	100 km	500 kg	?	1995/2004	
Hatf-1	Hatf-1	Single-stage	Solid	80 km	500 kg	?	1992	100

[157] Sources: official Pakistani data ; SIPRI Yearbook 2011; IISS Military Balance 2012; Jane's Strategic Weapons Systems; Bulletin of Atomic Scientists, Nuclear Notebook.

[158] Possibly also air- and sea-launched.

[159] Longer range (4,000-4,500 km) Shaheen-3 possibly in development.