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# Thinking about Pakistan's Nuclear Security in Peacetime, Crisis and War

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## INTRODUCTION

Bruce Riedel has captured global anxieties about Pakistan in a concise sentence, “It has more terrorists per square mile than anyplace else on earth, and it has a nuclear weapons programme that is growing faster than anyplace else on earth.”<sup>1</sup> The words carry extra weight coming from a career South Asia expert and co-chair of the Obama administration’s Afghanistan-Pakistan strategy review. Harvard Professor Graham Allison uses a similar juxtaposition, “When you map (weapons of mass destruction) and terrorism, all roads intersect in Pakistan.”<sup>2</sup> Consciously or unconsciously, Riedel and Allison’s words echo former President Bush’s dominant fear that the world’s most dangerous regimes and terrorists would threaten the United States with the world’s most destructive weapons.<sup>3</sup>

Pakistan is also one of two nuclear weapons-possessing states—the other being North Korea—for which there is a non-negligible risk of state failure. In March 2009 counter-insurgency expert David Kilcullen received considerable media attention when he feared, “We’re now reaching the point where within one to six months we could see the collapse of the Pakistani state.”<sup>4</sup> Kilcullen stressed the stakes involved in such a scenario, “We have to face the fact that if Pakistan collapses it will dwarf anything we have seen so far in whatever we’re calling the war on terror now.”<sup>5</sup> Riedel has framed the problem differently, though with equally weighty implications, “The possibility is now real that we will see a jihadist state emerge in Pakistan—not an inevitable outcome, not even the most likely, but a real possibility.... And that is the real strategic nightmare for the United States.”<sup>6</sup> Despite such fears, Pakistan neither collapsed nor fell to Islamist rule in 2009. However, it continues to face almost daily assault from terrorists and insurgents. The fact that it perseveres in the face of such pressure is remarkable, but tends to add to the pessimists’ case, even if at times the pessimists have exaggerated the imminence of Pakistan’s demise.

Pakistan’s past inability or unwillingness to control the A. Q. Khan nuclear supplier network further amplifies international concerns. For some analysts Pakistan is simply a state that cannot be trusted. In a 2004 article, Leonard Weiss emotively captured this sentiment, concluding, “Pakistan lied, stole, and conned its way to becoming a nuclear weapons power. Now it’s doing the same as a nuclear broker.”<sup>7</sup> Presumably, Weiss would argue it is continuing such behaviour as a failing state. Former

United Nations Weapons Inspector David Albright asked simply, “What other society has leaked nuclear secrets like Pakistan?”<sup>8</sup> Pakistan’s perfidy is amplified further, in the eyes of these analysts, by the refusal of the Pakistani state to force A. Q. Khan to speak to international investigators.

As a result of these concerns, serving US officials frequently face questions about Pakistani security from journalists and congressmen. Normally, officials have attempted to take a reassuring tone, while simultaneously acknowledging the gravity of the problem. When questioned in May 2009, the US Chairman of the Joint Chiefs of Staff, Admiral Michael Mullen, summarised his views on the topic:

I remain comfortable that the nuclear weapons in Pakistan are secure, that the Pakistani leadership and in particular the military is very focused on this... We, the United States, have invested fairly significantly over the last three years, to work with them, to improve that security. And we’re satisfied, very satisfied with that progress. We will continue to do that. And we all recognise obviously the worst downside... (is if) those nuclear weapons come under the control terrorists. I don’t think that’s going to happen. I don’t see that in any way imminent whatsoever at this particular point in time. But it is a strategic concern that we all share. And I’m comfortable that the military leadership in particular is capable of dealing with the particular issue right now.<sup>9</sup>

Also that month, the head of US Central Command, General David Petraeus, gave a similar assessment, saying, “With respect to the nuclear weapons and sites that are controlled by Pakistan..., we have confidence in their security procedures and elements and believe that the security of those sites is adequate.”<sup>10</sup> Both officers apparently reflect the views of President Barack Obama, who has stated, “We have confidence that Pakistan’s nuclear arsenal is safe; that the Pakistani military is equipped to prevent extremists from taking over those arsenals.”<sup>11</sup>

While there is a tremendous amount of discussion on the question of Pakistan’s nuclear security, much of it very quickly devolves into a binary “are they or aren’t they” debate. More so since many of the commentators on the matter are either serving or advising the US Government with access to sensitive classified information, the conclusions rather than the analytical underpinnings take centre stage.<sup>12</sup> This essay seeks to collate, sort through, and organise the reams of publicly available information and speculation to provide a systematic assessment of Pakistan’s nuclear security. It will attempt to concretise the problem by examining which scenarios are associated with what types of nuclear risks. Such a review of available evidence leads to the conclusion that the Pakistani state has taken visible and important steps to secure the arsenal.

What is not known, and in fact is unknowable, is whether such steps are sufficient given the prevailing threat environment in Pakistan. While this article will argue that the risk to Pakistan's arsenal has been exaggerated, this conclusion should not lead to complacency. The risks to Pakistan's arsenal are still unacceptably high, even if Pakistan has done much to combat them.

The review will examine how three factors condition Pakistan's nuclear security, somewhat independently of security measures taken by the Pakistani state. By far the most important factor is rising instability within Pakistan, which increases nuclear risk. The task of securing Pakistan's nuclear weapons is inseparable from the task of stabilising Pakistan. Second, larger numbers of nuclear weapons or larger amounts of precursor fissile material increase the magnitude of the security challenge. More things are harder to secure than fewer things. Keeping numbers lower should be an objective of those concerned about Pakistan's nuclear security. Finally, higher states of readiness for Pakistani strategic forces would likely be associated with greater risk of nuclear accident, inadvertence, or loss of control. Maintaining Pakistan's current relaxed nuclear posture facilitates security efforts. The essay concludes by examining the policy implications that emerge from this analysis.

## Dangers in Peacetime

### *Structure and Scale of Strategic Forces*

This survey of nuclear risk begins with an examination of Pakistani nuclear assets on a “normal day.” Such a “normal day” for this discussion would constitute essentially the present situation in Pakistan: a high terrorist threat, high levels of radicalism in Pakistani society, and insurgencies in Pakistan’s periphery (the Federally Administered Tribal Areas, the Northwest Frontier Province, and Baluchistan). How is the force configured and secured in peacetime to deal with this environment? This section will also examine threats to the civilian nuclear apparatus. It will conclude that during peacetime the system is reasonably secure, though the risk of insider threats and external attack is more pronounced than in any other established nuclear weapons state.<sup>13</sup> After establishing this baseline, subsequent sections will examine how such a system would likely respond under the stresses of conflict or large-scale domestic instability.

Pakistan’s nuclear arsenal is “India-specific” in the words of Pakistani officials. Pakistan seeks to leverage its nuclear weapons to limit India’s ability to apply strategic pressure on Pakistan, be that direct or indirect. There are few indications in the public domain to indicate that Pakistan has sized or oriented its arsenal to deal with a possible Iranian nuclear threat, nor does it appear to be overly focused of the possibility of a US counter-proliferation strike. Pakistan’s nuclear planners are concerned primarily with inflicting unacceptable punishment against India. Though Pakistani planners do not use this term, such a targeting strategy could be referred to as “finite deterrence.” “Finite deterrence” rejects the utility of disarming counterforce missions and instead believes that deterrence can be achieved by holding at risk an adversary’s population centres.<sup>14</sup> Pakistani planners believe that the large number of populous Indian cities make this a relatively easy task.<sup>15</sup>

In conversations with Pakistani military planners, one has the impression that they begin with this calculation of what constitutes unacceptable damage. This in turn is easily convertible into a number of warheads that need to be delivered above Indian soil.<sup>16</sup> Pakistani planners might inflate the number of warheads to be delivered depending on their confidence in the yield of the devices (including whether some percentage of the devices might not detonate at all) along with the accuracy and reliability of the delivery vehicles.<sup>17</sup> Pakistani planners explicitly take into account three other factors in assessing their strategic posture: (1) missile defences, which would affect the number of missile-borne

warheads that reach their targets; (2) airborne warning and control system (AWACS) aircraft, which would affect the number of aircraft- or cruise missile-delivered devices that reach their targets, and (3) the possibility of absorbing an Indian nuclear first strike. Pakistani planners also factor in some loss of aircraft, missiles, personnel, and warheads to Indian conventional counterforce missions and presumably have sought to design a nuclear command and control system that is resistant to counter-control strikes, be they nuclear or conventional.<sup>18</sup> To express this graphically:

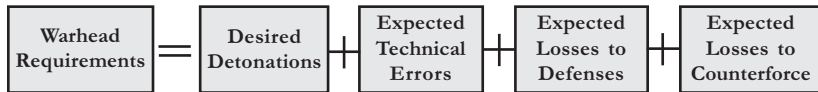


Figure 1: Notional Requirements Calculation

Thus, while Pakistani force sizing decisions are not driven by counterforce targeting philosophies or a desire for parity, there is an important degree of elasticity.<sup>19</sup> Pakistani national leadership periodically reviews strategic force levels to take into account changes in assumptions or calculations.

Fissile material production is difficult to hide completely from outside scrutiny, giving outsiders some sense of the scale of Pakistan's arsenal, though the exact size and fissile material production capabilities are matters of some controversy. Pakistan appears to be building a force of at least one hundred strategic warheads. In 2008, the International Panel on Fissile Materials (IPFM) estimated that Pakistan had "perhaps 65-80 weapons and may be increasing its stock by the equivalent of about six weapons worth per year," though the differences with the NRDC estimate can be explained by the fact that the IPFM report accounts for production after summer 2007.<sup>20</sup> A 2009 assessment by the Natural Resources Defense Council and the Federation of American Scientists concluded Pakistan might possess fissile material sufficient for 80-130 warheads, though the actual number of warheads was likely less than 100.<sup>21</sup> Other media accounts have placed the current weapons stockpile at between 80-100 warheads.<sup>22</sup> All estimates suffer from an inability to discern what portion of fissile material has been converted into warheads. For purposes of thinking about Pakistan's nuclear security, it seems prudent to assume that all fissile material has been machined into warheads, even if the reality is that some fraction of fissile material remains in a form not easily usable for military purposes.

Pakistan has both plutonium and highly enriched uranium (HEU) programmes for fissile material production. The IPFM's baseline estimate, for instance, assumes four weapons worth of material of production



from Pakistan's HEU programme (100 kg of HEU per year, 20 kg of HEU per weapon) and an addition 2 weapons worth of material from the plutonium route (10 kg per year, 5 kg of plutonium per weapon).<sup>23</sup> The IPFM further estimates that the two new reactors at the Khushab site could increase Pakistan's plutonium production capacity by an additional 20 kg a year (10 kg per reactor), or about four warhead equivalents per year. Both IPFM and NRDC experts have argued against the Institute for Science and International Security's (ISIS) 2006 estimates of the size of the new Khushab reactors.<sup>24</sup> ISIS estimated that one of those reactors could have the capacity to produce a staggering 200 kg of weapon-grade plutonium per year (say 40-50 weapons-equivalent), though its analysis was not accepted by most non-governmental analysts or the US Government spokespersons.<sup>25</sup> Even if ISIS's estimates are correct with regards to reactor capacity, Pakistan likely faces additional bottlenecks in uranium production, heavy water production, and plutonium reprocessing capacity that significantly constrain any rapid increase in fissile material production.<sup>26</sup>

Pakistan's highly enriched uranium production is equally tricky to determine with confidence. The IPFM baseline estimate assumes 100 kg per year of HEU production from the centrifuges at Pakistan's Kahuta location, but notes that Pakistan may also have centrifuge facilities at Gadwal, Golra, and Sihali with unknown enrichment capacities.<sup>27</sup> Beyond just the number of existing centrifuge cascades, their composition also matters. Pakistan has likely employed several types of centrifuge designs, all of which can operate at different levels of efficiency. Mark Hibbs has reported that there are perhaps four distinct centrifuge designs (P-1, P-2, P-3, and P-4). The IPFM estimate assumes a large P-2 cascade at Kahuta only. Manipulating the assumed mix of P-3s and P-4s alters both the present-day estimate of Pakistan HEU stockpiles and the potential growth curves. Hibbs's reporting indicates the P-3 may have been more than twice as efficient as the P-2, with the P-4 being perhaps four times as efficient as the P-2.<sup>28</sup> The rate at which Pakistan phased in these newer centrifuges is unclear. The IPFM experts assume that Pakistan restrained HEU production from 1990 to 1998 under US pressure. Their baseline estimate of 65 weapons worth of material assumes 1400 kg of HEU, the estimate of what P-2s at Kahuta could produce. If, however, Pakistan quickly shifted to P-3s after resuming full-scale enrichment in 1998, the upper end IPFM estimate reaches as high as 2800 kg of HEU—or around 135 weapons worth of material—as of 2008.<sup>29</sup> Pakistan's limited natural uranium supply means that there is an upper bound to fissile material production. IPFM experts estimate, for instance, that once

Khushab-II and III reactors are operational, the reactors will require “virtually all of the natural uranium that Pakistan produces.”<sup>30</sup> Further, even if Pakistan was able to phase in the much more efficient P-4 centrifuges, the HEU production line alone might have reached levels of separation efficiency that would have outstripped Pakistan’s ability to provide feed natural uranium, placing another upper bound on both the current baseline estimate and future projections.<sup>31</sup>

Thomas Cochran of the NRDC has argued that Pakistan might be able to make more efficient use of its fissile material using a composite warhead (with perhaps a 2-3 kg plutonium sphere surrounded by a shell of highly enriched uranium), and consequently could expand its nuclear arsenal at a rate perhaps 50-60 per cent higher than conventional estimates.<sup>32</sup> Conservative estimates—assuming mostly P-2 centrifuges, setting aside the ISIS Khushab-II and III figures and without assuming a composite warhead—would be around 70-85 weapons-worth of fissile material, with an additional rate of perhaps 6 new additional weapons-worth a year, a number that will increase to perhaps 10 new weapons-worth a year by the completion of all three Khushab reactors in the 2011-2014 time-frame. A reasonable estimate for planning purposes might place the Pakistani strategic force at between 80-250 warheads within the next decade.

In the event of nuclear use, these warheads could be delivered by a multiplicity of delivery vehicles. Pakistan has aircraft capable of delivering nuclear warheads, has developed and deployed nuclear-capable liquid- and solid-fuel ballistic missiles, is developing air- and ground-launched cruise missiles, and has indicated its intent to develop a sea-based cruise missile.<sup>33</sup> Ballistic missiles appear to rely on road-mobility for survivability (the advantages and disadvantages of which will be discussed below).

	Range	Numbers (if available)
<b>Pakistani Aircraft</b>		
F-16 A/B	925 km	46 planes in inventory
F-16 C/D	1,370 km	18 scheduled for delivery (2010-2011)
Mirage 5 PA	1,300 km	50 planes in inventory
<b>Pakistani Ballistic Missiles</b>		
Hatf 1	80 km	Unknown
Hatf 2 (Abdali)	180 km	Unknown
Hatf 3 (Ghaznavi)	400 km	Fewer than 50 Hatf-3 and Hatf-4 launchers
Hatf 4 (Shaheen 1)	450+ km	Fewer than 50 Hatf-3 and Hatf-4 launchers
Hatf 5 (Ghauri 1 and 2)	1275 km	Fewer than 50 Ghauri launchers
Hatf 6 (Shaheen 2)	2000+ km	Unknown
<b>Pakistani Cruise Missiles</b>		
Babur (Ground-launched)	320 km	Unknown
Ra'ad (Air-launched)	320 km	Unknown

**Table 1: Pakistani Delivery Systems**

While hardened silos could confer Pakistan a significant defence against Indian counterforce strikes, there is no credible evidence that they have built such silos.<sup>34</sup> Pakistan's nuclear-capable missiles and aircraft may play a dual-use role, so any individual launcher or aircraft might not be associated with a corresponding warhead (and a launcher could be associated with multiple missiles). Table 1 lists the delivery systems and public estimates of their numbers.<sup>35</sup>

In terms of thinking about Pakistan's nuclear security, however, there appears to be consensus among public sources that Pakistan's nuclear warheads are de-mated from delivery vehicles during peacetime. In other words, rather than dozens or hundreds of delivery vehicles and warheads to secure at different locations, the security problem likely entails a much smaller number of warhead storage sites. Then-President Pervez Musharraf said in January 2003, "This is not [a] Warsaw Pact vs. NATO situation where warheads and missiles are ready to fire with a button in hand. There is no button in our case. The missiles and warheads are not permitted together. There is a geographical separation between them."<sup>36</sup> Musharraf's statement is corroborated by several official and unofficial non-Pakistani sources.

It is less clear if these de-mated warheads are also stored in a partially disassembled state, with fissile cores perhaps stored separately from their triggers.<sup>37</sup> The 2001 US Defence Department report on *Proliferation: Threat and Response* states, "Islamabad's nuclear weapons are probably stored in component form" and that "Pakistan probably could assemble the weapons fairly quickly...."<sup>38</sup> Ashley Tellis of the Carnegie Endowment of International Peace (and a frequent advisor to the US Government on South Asian nuclear matters) testified to a US Congressional subcommittee in January 2008:

I think Pakistan's nuclear weapons routinely are maintained in non-assembled form. The assembly generally takes place under conditions of incipient crisis and in accordance with a set of guidelines, depending on the gravity of the threat. So on a day-to-day basis, I don't think there is any danger of certainly the safety of the weapon—that is, the weapon inadvertently being detonated or exploding—because no fully ready devices, as best one understands from the literature on the subject, seem to exist. So you're really dealing with parts of an arsenal as opposed to a complete ready arsenal.<sup>39</sup>

Secretary of State Clinton told Congress in April that Pakistan's nuclear weapons are "widely dispersed in the country — they are not at a central location."<sup>40</sup> Other media accounts are similar. *New York Times* reporter David Sanger wrote in 2007, Pakistan's "weapons are kept separate from

delivery systems, nuclear cores from their detonators.”<sup>41</sup> Without attribution of his sources, *Associated Press* journalist George Jahn has reported, “Pakistan’s 60 plus warheads are believed to be stored separately from their delivery systems, with the nuclear cores removed from their detonators. The weapons are dispersed in as many as six separate locations, most south of the capital.”<sup>42</sup> Whether or not Jahn’s sources are accurate, available evidence plausibly points to a single-digit or low-double digit number of storage sites de-mated and perhaps partially disassembled nuclear warheads, dramatically reducing the number of sites that must be secured from outsider and insider threats.

### *Command, Control, and Security*

Having examined the scale and general disposition of Pakistan’s nuclear force, what steps has the Pakistani state taken to secure its arsenal? In some ways the story of Pakistani nuclear command and control is the story of one organisation—the Strategic Plans Division—and how it sought to operationalise the deterrent after 1998, to come to grips with the A. Q. Khan nuclear supplier network, and most recently to alleviate international concerns about Pakistan’s nuclear weapons.

In 1998, the then Major General Khalid Kidwai was appointed by then-Army chief, General Jehangir Karamat, to oversee an Evaluation and Research (E&R) cell. While the cell was not actively involved in nuclear matters, following the Chagai tests, Karamat asked Kidwai to provide recommendations on nuclear command and control. The main outlines of the E&R proposal would form the backbone of the subsequent Pakistani command and control arrangement: a National Command Authority (NCA) composed of political and military leaders, a supporting secretariat to the NCA, and specialised strategic forces. The E&R recommendations were largely complete by fall 1998, but the unexpected transition from General Karamat to General Musharraf delayed their implementation. Following General Musharraf’s approval of the scheme in December 1998, it was briefed to then-Prime Minister Nawaz Sharif in April 1999. Negotiations over the composition of the NCA and its constituent committees did not end until after the October 1999 military coup. Finally, in February 2000 the National Security Council approved the creation of the National Command Authority, the Strategic Plans Division (NCA’s secretariat), and service-specific strategic forces commands (see figure 2 below). Kidwai was selected to head the new Strategic Plans Division, or SPD, ultimately earning a promotion to three-star rank.<sup>43</sup> He has remained in that position, even after his retirement from the Pakistan Army in 2007.<sup>44</sup>

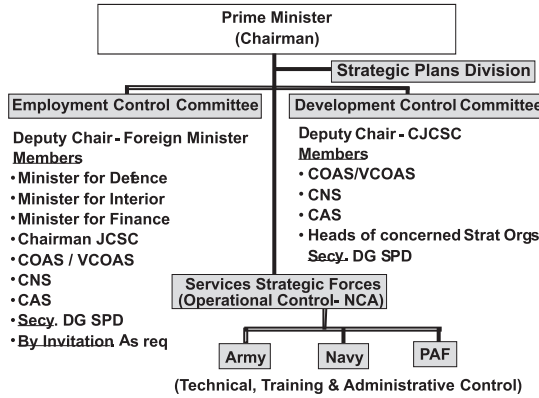


Figure 2: Pakistan’s National Command Authority<sup>45</sup>

Kenneth Luongo and Brig. (Retd.) Naeem Salik have provided the most definitive public description of the SPD as it is presently composed.<sup>46</sup> The Strategic Plans Division has four primary directorates as well as a security division (see figure 3). The security division is composed of 9,000-10,000 personnel reporting to a serving two-star general. By far the largest component of SPD, the security division provides internal and external security for nuclear-related sites. The remaining directorates are:

- the Operations and Planning directorate;
- the C4I2SR (computerised command, control, communications, information, intelligence, and surveillance) directorate;
- the Strategic Weapons Development directorate, which interfaces with and provides budgetary oversight for the nuclear weapons research and development organisations; and
- the Arms Control and Disarmament Affairs directorate, which provides military advice on arms control and non-proliferation negotiations.



Figure 3: Pakistan Strategic Plans Division<sup>47</sup>

Also reporting directly to the National Command Authority are the services' strategic forces commands. As described by Luongo and Salik, "The primary responsibility of these commands is to exercise technical, training, and administrative control over the strategic delivery systems. The operational control, however, rests with the NCA."<sup>48</sup>

During peacetime, SPD is responsible for protecting Pakistan's strategic programmes from insider and outsider threats, most importantly from theft or loss of nuclear material and against infiltration of the strategic organisations by ill-intentioned actors. It does so through a combination of secrecy, physical security, counter-intelligence teams, personnel screening programmes, procedural controls, and technical controls.

Secrecy is Pakistan's most important protective measure against external threats. If adversaries—be they foreign governments or non-governmental actors—are unaware of the locations of nuclear materials, they cannot threaten them. Historically, information regarding the location of Pakistan's warheads and delivery vehicles has been very tightly controlled by Pakistan's Strategic Plans Division, and is not shared with regular military officers or intelligence officials in the vicinity of such sites.

Secrecy is in tension with the second most important protection against external threats: physical security. In other words, the strongest physical security measures will be visible to outsiders and may paradoxically make the site less secure. Rolf Mowatt-Larsen, a former head of the US Department of Energy's intelligence and counter-intelligence efforts, described "[a]nother precaution taken by the Pakistani military is to maintain strict secrecy over the location of storage sites and to transport and deploy weapons clandestinely rather than in convoys that have a stronger, highly visible security profile. These security precautions produce few visible signs of movements, thereby lowering the risks associated with possible theft of or attack on weapons at their most vulnerable point, in transit."<sup>49</sup>

Luongo and Salik have described a three-tier security perimeter for nuclear sites, all three of which are the responsibility of SPD. The innermost perimeter was historically the responsibility of the concerned strategic organisations. Following the A.Q. Khan scandal, Pakistan identified Khan's oversight of Khan Research Laboratory security staff as a key deficiency and SPD's security division overtook responsibility for the inner perimeter. A second-rung consists of fencing, electronic sensors, cameras, and security personnel. Finally, counter-intelligence teams work on identifying threats.<sup>50</sup> According to Peter R. Lavoy, an American

academic and government official who has interacted regularly with SPD, a one-star SPD Brigadier General oversees these counter-intelligence teams. Lavoy describes the setup, “This organisation essentially coordinates with all intelligence agencies about any external threats. The Inter-Services Intelligence Directorate (ISID) forms the outermost ring of security and works closely with the security division. Prior to this, there was no formal role for the ISID in nuclear matters. Even now, the ISID director general is not a formal member of the NCA. (Reportedly, he is a regularly invited member).”<sup>51</sup>

Within the guarded compounds, Pakistani officials must ensure individuals are not abusing their authority. They must first filter out good from bad actors and reliable from unreliable personnel. Pakistan has established Personnel and Human Reliability Programmes (PRP and HRP, respectively) to screen military and civilian personnel involved in strategic programmes. Based on accounts of discussions with Lt. Gen. Kidwai and written descriptions by retired Pakistan SPD officials, the programme is administered by SPD in conjunction with Pakistan’s three intelligence agencies (ISID, military intelligence, and the Intelligence Bureau). Screenings are repeated regularly every two years, and sometimes on a random basis. This process scrutinises all aspects of an individual, including lifestyle factors such as his friends, family, and political views. For lower-level military personnel, apparently only five per cent passed the rigorous screening process as of 2002.<sup>52</sup> Earlier, top individuals within a strategic organisation were exempt from screening procedures, though indications are this shortcoming was rectified after the A. Q. Khan scandal glaringly demonstrated the dangers of such an approach.<sup>53</sup>

The scale of the problem is daunting. Lt. Gen. Kidwai has estimated that approximately 70,000 people work in the nuclear complex in Pakistan, including 7,000 to 8,000 scientists, of which approximately 2,000 have “critical knowledge.”<sup>54</sup> One anonymous US official reportedly expressed concern over what he believed to be “steadfast efforts of different extremist groups to infiltrate the labs and put sleepers and so on in there.”<sup>55</sup> A particular challenge for Pakistan will be keeping track of the growing number of retired scientists and other personnel with sensitive knowledge.<sup>56</sup> The most egregious case of Pakistani scientists interacting with militant Islamists involved two retired scientists from the Pakistan Atomic Energy Commission—Chaudry Abdul Majeed and Sultan Bashiruddin Mahmood—who reportedly met with al Qaeda leader Osama bin Laden in Afghanistan in 2001.<sup>57</sup>



In light of the inherent limitations on any screening programme, Pakistan employs procedural safeguards to ensure that even vetted personnel do not access the most sensitive nuclear items, most importantly warheads, without following strict protocols. One procedural safeguard was discussed earlier: nuclear warheads are stored partially disassembled and de-mated. If triggers and warheads are stored separately, for which there is some evidence, then this even further defends against an external threat, which would have to “knock over two buildings to get a complete bomb,” in Harvard expert Matthew Bunn’s phrase.<sup>58</sup> The A. Q. Khan episode identified a lack of external nuclear material protection, control, and accounting (MPC&A), a procedural deficiency SPD has moved to rectify. Brig. (Retd.) Khan describes the current system introduced by SPD as involving “regular and surprise inspections to tally material production and waste in order to maintain transparency and accountability.”<sup>59</sup>

In 2006, Lt. Gen. Kidwai reportedly stated that Pakistan also employed the “functional equivalent to the two-man rule and permissive action links (PALs).”<sup>60</sup> In 2002, Kidwai referred to a “three-man rule” for “any procedure involving nuclear weapons.” Subsequent writings by Feroz Hassan Khan and Naeem Salik, both former deputies of Kidwai, have referred to a “two-man rule” that in some situations becomes a “three-man rule.” Neither Khan nor Salik explain when one rule versus the other applies, nor do they identify who the “men” in question might be. One possibility is that the three men are the missile launch team commander, a representative from the Strategic Plans Division (SPD) with the missile team, and the head technician from the strategic organisations.<sup>61</sup> It is unclear whether these individuals receive a common set of instructions via one communications channel, or whether they receive multiple orders from their respective scientific and military chains of command.

Pakistan then employs some combination of technical measures to ensure procedural measures are being followed. The trickiest area of discussion regarding Pakistan’s nuclear weapons involves permissive action links (PALs). As the Kidwai quote earlier noted, some sort of “functional equivalent” is in place, but details matter. Luongo and Salik, citing a 2004 television interview with former Pakistani nuclear scientist Samar Mubarakmand, state that every Pakistani warhead is now fitted with a “code-lock device,” which requires a proper code to enable the weapon.<sup>62</sup> In a more recent piece by Air Commodore Khalid Banuri and Adil Sultan, serving and recently retired SPD officials respectively, they



summarise the controls in slightly less fail-safe terms: “To preclude any possibility of inadvertent or unauthorised use of nuclear weapons, Pakistan has developed physical safety mechanisms and firewalls both in the weapon systems themselves and in the chain of command. No single individual can operate a weapons system, nor can one individual issue the command for nuclear weapons use.”<sup>63</sup> “No single individual can operate a weapon system” is a much lower standard than two individuals must input a code provided by the National Command Authority into a nuclear device prior to it being usable, which is the implication of the Luongo and Salik piece. Ashley Tellis has distinguished between multiple categories of PALs. Rudimentary measures—what Tellis refers to as Category A or B PALs—that “are essentially padlocks on containers which contain strategic materials,” which Tellis believes “the Pakistanis are actually capable of doing on their own, and it is my judgment that they’ve already moved some ways in producing technologies indigenously of this kind.” Tellis is less certain that more sophisticated technologies such as design-embedded PALs integral to the design of a nuclear weapon—what he refers to as Category C PALs and beyond—are available or should be made available to Pakistan.<sup>64</sup> Thinking about multiple types of PALs is helpful, because it is possible that many of the technical barriers to nuclear use are eliminated when weapons are removed from storage and mated to delivery vehicles. Public statements by SPD officials do not discount this possibility.

Pakistan’s recent work on nuclear security has been quietly assisted by the US Government, according to a growing number of public statements by Pakistani and US officials. US officials have stressed that the programmes have improved security, as in Admiral Mullen’s May 2009 comments referenced earlier that “the United States, have invested fairly significantly over the last three years, to work with them, to improve that security. And we’re satisfied, very satisfied with that progress.”<sup>65</sup> Mullen’s comments echo earlier statements by former Deputy Secretary of State Richard Armitage, who said, “We have spent considerable time with the Pakistani military, talking with them and working with them on the security of their nuclear weapons. I think most observers would say that they are fairly secure. They have pretty sophisticated mechanisms to guard the security of those.”<sup>66</sup>

According to the *New York Times*, the United States has transferred around \$100 million worth of training, equipment, and other aid to Pakistan for this purpose.<sup>67</sup> Permissive action links do not appear to have been part of any assistance; both because of US legal limitations

but also because of Pakistani sensitivities that US technical assistance might jeopardise Pakistan's freedom of action during an extreme crisis. According to Feroz Khan, "In 2001, US Secretary of State Colin Powell offered nuclear security assistance to Pakistani President Gen. Pervez Musharraf. The SPD carefully examined the offer and accepted training but declined technology transfers, which they perceived as intrusive or likely to compromise programme secrecy.... There has been no further acceptance of any assistance [beyond training], especially permissive action links (PALs)...."<sup>68</sup>

One final consideration is how this system might evolve over time, in response to "normal" stresses short of major domestic instability. Over the coming years, the Pakistani Government could easily encounter serious economic crisis with implications for the government's fiscal picture. Already there were reports in the Pakistani media in 2009 that the nuclear programme is facing steep budget cuts.<sup>69</sup> Organisationally, there may be incentives to prioritize fissile material production over security. Also, morale and loyalty could suffer in the face of salary reductions, staff cutbacks and other signs of fiscal stress. These sorts of problems bedevilled the much larger nuclear infrastructure of the former Soviet Union and resulted in the US Cooperative Threat Reduction programme as a means to alleviate the most serious risks. In the Pakistani context, the United States and other concerned states might not be aware of such fiscal stresses and their impact on security until after there was a slippage in security. Further, even if outsiders were aware of the fiscal challenges and sought to alleviate their affect on security, there would be difficult policy choices associated with providing fiscal support, which would in effect subsidise Pakistan's nuclear weapons programme. There is no easy answer, but maintaining links between the United States and the Pakistani nuclear establishment makes it much more likely that the international community will be aware of such risks and can calibrate countervailing policies.

A final concern that is sometimes raised by outside analysts is that the Strategic Plans Division might be subject to pressure by political parties to place favoured individuals within the strategic organisations, sometimes viewed as part of a larger tussle between the military and civilians to control the nuclear establishment. Given civil-military relations in Pakistan, the military seems quite able to resist such civilian pressure in an area that the military views as core to Pakistan national security, and the existing SPD policy to refuse political appointments seems likely to remain intact.<sup>70</sup> The still-baffling November 2009 decision of President Asif Ali Zardari to relinquish nuclear responsibilities to Prime Minister Syed Yousuf Raza

Gilani can have many interpretations; none of those interpretations seem to indicate greater civilian control over the military's nuclear mission.<sup>71</sup>

### *Peacetime Threats*

Having reviewed Pakistan's command and control arrangement, how well does it protect the nuclear arsenal against likely peacetime challenges? Given the low levels of readiness, most importantly de-mated and partially disassembled warheads, many of the peacetime scenarios associated with nuclear risk from the Cold War do not apply. Since the Pakistani nuclear force is not configured to confront a "bolt-out-of-the-blue" surprise attack, it is difficult to conceive of a scenario whereby an individual inadvertently or accidentally launches a nuclear device. Peacetime nuclear accidents are also less likely if cores and their triggers are stored separately, though other accidents might still occur. Transportation accidents or fires could lead to the inadvertent detonation of high explosives surrounding the fissile material core, even if the electrical triggers were removed. While it is improbable that such a detonation would trigger a nuclear yield, it cannot be entirely ruled out, particularly given the paucity of Pakistani nuclear tests, which would prevent Pakistani designers from being able to repeatedly test to see if the design was "one-point safe."<sup>72</sup> Much more likely is that such an explosion would disperse fissile material, akin to a "dirty bomb."

While such risks remain, they are vastly reduced compared to the US and Soviet Cold War experience. While the United States and the Soviet Union had many more tests to ensure the safety of their weapons, any comfort from testing was nullified by much higher states of readiness and far larger numbers than the Pakistani context. While Pakistani nuclear weapons-transport patterns are justifiably secret, there is no reason to suspect that such movements are common, and certainly not as common as during the Cold War. Further, as will be discussed in more detail later, the seriousness with which Pakistani nuclear scientists have taken in safeguarding transport of civilian nuclear materials also indicates they are aware of the dangers associated with warhead transport and likely have taken appropriate safety countermeasures.

In addition to routine accident, during periods of relative normalcy Pakistani nuclear technology faces threats from outsiders attempting to penetrate security and seize sensitive nuclear materials or technology or insiders that seek to steal such items. Terrorist groups have shown their willingness to target secure installations, including nuclear-related facilities and personnel. Many of these complexes have primarily conventional missions—in fact, it is often impossible to discern whether they have

been targeted because of their conventional role or because of their possible nuclear one. In only one attack against sensitive military installations have terrorists demonstrated an ability to penetrate perimeter security. In all other instances, casualties have occurred either at the perimeter or on soft targets (such as buses) away from the base. What has occurred, though, is still disconcerting, because it does show the ability of terrorists to elude security in garrisoned cities and strike targets of strategic importance for Pakistan, even if those targets may or may not have nuclear-related materials.

In 2007, two Pakistan Air Force (PAF) facilities associated with Pakistan's nuclear weapons complex were targets of attacks. A suicide bomber attacked a bus carrying personnel to the Sargodha Air Force base on November 1, 2007, killing seven PAF officers and three civilians.<sup>73</sup> Sargodha is the home of two of Pakistan's F-16 squadrons. Given that the F-16 aircraft may be capable of delivering a nuclear device, there has been considerable speculation that Sargodha may house nuclear weapons.<sup>74</sup> On December 10, 2007, a suicide attacker targeted a school bus carrying children of PAF personnel outside of the Kamra Air Force base.<sup>75</sup> Despite some of the commentary following this attack, there are not strong indications as to whether Kamra is a regular storage site for nuclear material.<sup>76</sup> While the Air Weapons Complex at Kamra is reportedly involved in a variety of tasks relating to air munitions, and may have played a role in adapting Pakistan's air delivery vehicles for nuclear missions, there is no reason to suspect this past developmental role is ongoing. Nuclear weapons could be stored in the vicinity of Kamra if the Mirage V squadron there has a nuclear delivery mission.<sup>77</sup> In both the Sargodha and Kamra cases, an attack on a bus outside of the facility—a soft target—is not the same thing as an attack on the base itself, which is protected by layers of security.

Perhaps the most worrisome attack against a suspected strategic facility occurred outside the Pakistan Ordnance Factories compound at Wah on August 21, 2008. Two suicide bombers reportedly approached the facility on foot and detonated their devices at two busy entrances during a shift change in the compound. The attack killed 70 and injured over 100, making it one of the deadliest single attacks in Pakistan's tumultuous recent history. The Pakistani Taliban claimed responsibility for the attack.<sup>78</sup> Because of Wah's extensive explosives-related infrastructure, it is commonly considered to be an assembly site for Pakistan's nuclear weapons.<sup>79</sup> Some context is important. Contemporary Pakistani press accounts, including those in which the Taliban take credit for the attack,

focus solely on the Wah facility's role as a producer of conventional munitions.<sup>80</sup> The scale of the complex is vast containing fourteen different factory lines and employing up to 20,000 workers.

More recently in July 2009, a suicide bomber struck a bus that may have been carrying Khan Research Laboratories personnel, wounding thirty workers.<sup>81</sup> There are some indications the bus may have been targeted because of its markings as a government vehicle, rather than any ties to the nuclear programme.<sup>82</sup> Even so, at Khan Research Laboratories, it is uncertain if warheads are present, since the laboratories' primary focus is on uranium enrichment. Reshmi Kazi, an Indian analyst, has stressed rightfully that highly enriched uranium, even when not machined and assembled into a nuclear weapon, represents substantial nuclear risk. While still difficult, organisations with the correct technical and scientific expertise could construct a gun-style uranium device if they managed to obtain sufficient fissile material.<sup>83</sup> (By contrast, a plutonium-based implosion-style device would be far harder for a non-state actor to produce, even if it was able to procure the fissile material.) Even assuming the bus carrying KRL workers was targeted specifically, an attack on a bus is clearly not the same as an attack on KRL itself.

Two attacks by Baluch militants on suspected Pakistan Atomic Energy Commission facilities at Dera Ghazi Khan have also drawn international attention.<sup>84</sup> Dera Ghazi Khan is located in the western district of Punjab, bordering the restive Baluchistan province. On April 26, 2003, over a dozen armed attackers launched a brief raid against what contemporary news articles refer to as the PAEC's Salary Camp, which appears to be a place name in Dera Ghazi Khan district. No one was injured in the attack, which apparently sought to pressure PAEC authorities to hire more local staff.<sup>85</sup> On May 15, 2006, Baluch militants allegedly launched mortars onto a supposed dumping site near Baghalchur Uranium Mine in Dera Ghazi Khan, sparking a fire in the nearby woods.<sup>86</sup> The importance of both attacks is difficult to ascertain, both because of very fragmentary contemporary press coverage, but also because the status of the facilities at Dera Ghazi Khan is uncertain. Pakistani officials claim that the uranium mine at Baghalchur was closed in 1999. Pakistani authorities have not clarified the status of other infrastructure at Dera Ghazi Khan, though at least one Pakistani news article implies that the facilities are largely non-operational.<sup>87</sup> The Baghalchur site is apparently being used for storage of nuclear waste.<sup>88</sup> The Institute for Science and International Security identified a number of new industrial buildings, new anti-aircraft installations, and new settling ponds in its comparison

of satellite imagery from 2004 and 2008. Collectively, ISIS's findings do seem to indicate that some sort of nuclear activity in the facilities around Dera Ghazi Khan exists, making the attacks in 2003 and 2006 worrisome to international observers. Without knowing more about the severity of these attacks or the nature of the facilities, it is difficult to know how to assess these incidents.

Collectively, what does this series of attacks indicate about the risk of external attacks? Clearly, of all of the nuclear weapons-possessing states, Pakistan has the most permissive environment for violent, non-state actors. Of all of the probable attacks on nuclear-related facilities, the most worrisome is the 2008 attack at Wah, followed closely by the hazy reports of attacks near Dera Ghazi Khan in 2003 and 2006. Most of the other attacks occurred near nuclear-related facilities or occurred on personnel en route to such facilities, but did not present a threat to perimeter security itself. In none of the attacks on possible nuclear facilities were their reports that attackers managed to breach perimeter security. Further, secrecy surrounding Pakistan's nuclear storage sites makes it uncertain to an attacker (or an analyst) if any given location actually contains nuclear material or technology.

Shaun Gregory concluded in his 2009 analysis of similar attacks, "...[E]mpirical evidence points to a clear set of weakness and vulnerabilities in Pakistan's safety and security arrangements."<sup>89</sup> This conclusion is too strong. Empirical evidence points to a real threat against Pakistan's strategic facilities. So far, there is no evidence one way or another whether such an external threat can overwhelm or penetrate the security measures put in place to guard nuclear facilities.

There is one clear example, though, of an attack that did succeed in breaching perimeter security of a compound of strategic importance to Pakistan, albeit one that no one alleges contains nuclear weapons. On October 10, 2009, a group of approximately nine gunmen—some dressed in Army uniforms—attacked the Pakistan Army General Headquarters in Rawalpindi. While four attackers apparently were killed at the front gate, where the assault began, five personnel managed to penetrate perimeter security. Inside, they proceeded to take over forty hostages. The following day, Pakistani commandos retook the compound and killed or captured the gunmen. Counting commandos killed in that rescue operation, Pakistani media report eight Pakistan military personnel killed, including one brigadier and one lieutenant colonel.<sup>90</sup> What to make of such an attack? It demonstrated that determined attackers, using deception and relatively large numbers, were able to overwhelm

GHQ's outer-ring of security. Once inside, the attackers were able to take hostages and operate for approximately 18 hours before Pakistani commandos ended the affair. While distressing, there are elements that are somewhat reassuring about this otherwise disturbing episode. First, the militants were able to get in, but not out. Second, while it is distressing that militants succeeded in breaching the GHQ compound, it is not directly analogous to threats against nuclear sites, which are guarded first and foremost by the secrecy of their locations. The GHQ front gate is an obvious landmark for anyone that has been to Rawalpindi. Secrecy remains the most important bulwark against attacks on Pakistan's nuclear facilities.

A threat that is less observable, but no less challenging, is that posed by an insider working within strategic organisations to steal nuclear material or technology. Pakistan has designed its security measures largely based on lessons learned from the A.Q. Khan and Majeed-Mahmood episodes.<sup>91</sup> As a result, Pakistan has put in place a series of procedural and technical safeguards to mitigate the insider threat, most importantly: the human reliability programme, the "two-man" rule, a functional equivalent to a permissive action link, storing weapons partially disassembled, and material protection, control, and accounting techniques. Collectively, these safeguards complicate the ability of a bad actor to gain access to strategic technologies, to act alone, to detonate the device, and to be able to act without risk of discovery.

Analysts have focused primarily on the inherent weaknesses of any vetting programme, though often not within the context of a broader system designed to restrain individual action even if vetted. Such analysts often point to a broader radicalisation in Pakistani society. Pakistani physicist Pervez Hoodbhoy argues, "Pakistan's 'urban Taliban,' rather than illiterate tribal fighters, pose a nuclear risk. There are indeed more than a few scientists and engineers in the nuclear establishment with extreme religious views."<sup>92</sup> Indeed, academics have noticed a tendency for engineers in particular to be overrepresented among Islamic terrorists.<sup>93</sup> Also, the Pakistan Army has typically recruited heavily in northern Punjab and the Northwest Frontier Province, including some areas that suffer from fierce insurgencies today. Military personnel sympathetic to insurgents cannot be discounted.<sup>94</sup>

Those concerned about Pakistan's nuclear security normally give one of three specific examples of insider military threats. First, they question whether the powerful Inter-Services Intelligence (ISI) Directorate has become too sympathetic to the Islamic militant groups that it has funded



and trained since the 1980s. Furthermore, they note ISI's increased role in recent years in protecting Pakistan's nuclear weapons from threats. In India, such commentators will normally view the ISI as symptomatic of a broader military establishment that is prone to religious zealotry. In the United States, this concern is normally framed in terms of a rogue intelligence agency, often insubordinate to the desires of its political masters. The most parsimonious explanation is that the ISI is a professional organisation that has been directed to maintain contacts and provide support to militant organisations as a matter of state policy. Large portions of ISI's officer corps are seconded to ISI from the mainline Army for rotations, and the ISI leadership in recent years has been thoroughly a product of the mainline Army. Hamid Gul, the former ISI chief from 1987-1989, is to some extent the indelible outside image of the ISI: a religious zealot with fierce anti-US and anti-Indian tendencies. Gul's image is so glaring, that people overlook a string of professional military men that have headed the organisation in recent years: Ehsan ul-Haq, Ashfaq Kayani, and currently Ahmed Shuja Pasha. Concerns about ISI should not be ignored either by outsiders or Pakistanis. Certainly, such concerns reinforce the need to have a personnel reliability programme that exempts no one. An ISI officer with knowledge of nuclear matters should face the same stringent requirements as any other officer.

The second, more concrete example relates to large-scale surrenders by Pakistani security forces to Taliban militants. While such incidents have been rare, any report of company-sized captures indicates serious problems with morale in a fighting force. Most of the examples involve poorly trained and poorly equipped Frontier Corps or police forces, though there is at least one report of regular Pakistan Army troops also being captured in large numbers.<sup>95</sup> While the Pakistan military has disputed some of these accounts, the reports certainly would call into question the ability of Pakistan's nuclear guardians to withstand an assault by a larger force, particularly if that force was composed of ethnic Pashtun or Punjab kin. There are three principal differences between the surrenders in Pakistan's northwest and how SPD's security division might be expected to fare against an external assault. First, SPD personnel undergo rigorous screening for loyalty. Second, SPD personnel are likely to be guarding fixed sites in or near the Punjabi heartland. They are unlikely to be cutoff from reinforcements. Third, SPD personnel are likely better equipped and trained, certainly more so than police or Frontier Corps forces and perhaps more so than mainline Army troops.

The final concern, and perhaps the most serious, regards the involvement of military personnel in assassination attempts against



President Musharraf. Both heads of state and nuclear weapons receive the most intensive security that a country can provide. The analogy is a weak one. Different services perform the two different security missions. Presidents must interact with the public, but nuclear weapons can be kept locked behind gates. However, if the state cannot prevent insiders from infiltrating presidential security, what chance does it have in preventing infiltration into a nuclear apparatus that is likely to be larger in size?

Here too, the Pakistani record is alarming, though not as alarming as it first appears. Military personnel were involved in perhaps two assassination attempts against Musharraf: one in mid-December 2003 and another in late September 2006. In the December 14, 2003 attack, a number of low-ranking Air Force personnel as well as a handful of Army troops were involved in emplacing and detonating explosives on a bridge in Rawalpindi regularly crossed by Musharraf.<sup>96</sup> Similarly, there are reports, denied by official Pakistan spokespersons, that Air Force personnel were involved in a crude September 2006 plot, in which rockets were rigged to fire at President Musharraf's residence in Rawalpindi.<sup>97</sup> In neither case, do reports indicate that any of the alleged plotters had received secondary screening over and above that required for normal military service. Nevertheless, it is deeply worrisome to see dozens of Pakistan military personnel implicated in plots against their commander-in-chief.

The insider threat is perhaps the most serious faced by the Pakistani arsenal. There is a large pool of radicalized individuals within Pakistani society, some of which previously have been recruited to work for the Pakistani state and military. Several serious attacks have demonstrated insider involvement. The Pakistani nuclear guardians have established comprehensive vetting programmes, but it will remain an open question of whether these are sufficient to screen out all bad actors. In such instances, Pakistan's nuclear security will be dependent on technical and procedural safeguards to limit the damage of the insider threat.

### *Pakistan's Civilian Nuclear Establishment*

Pakistan's nuclear risk is not limited to just its military and strategic programmes. Pakistan's civilian nuclear infrastructure also faces potential risks, though to date there are no examples of a Pakistani civilian nuclear facility being targeted by terrorists. Pakistan currently has two operating nuclear power plants (the Karachi Nuclear Power Plant, KANUPP, and the first Chasma Nuclear Power Plant, CHASNUPP-1) and one plant under construction (CHASNUPP-2). All three plants operate under

International Atomic Energy Agency safeguards. CHASNUPP-2 is scheduled to become operational around 2011, while KANUPP's plant lifetime could reach its end around 2012.<sup>98</sup> KANUPP's reactor design may discharge near weapons-grade plutonium, making KANUPP's spent fuel pool a potentially attractive target.<sup>99</sup> Unlike Pakistan's strategic facilities, Pakistan civilian nuclear power plants are well known and cannot be hidden from potential attackers.

In his extensive review of Pakistan's civilian nuclear infrastructure, Stanford University nuclear expert Chaim Braun focuses his concern on the possibility of a rapid expansion of Pakistan's nuclear infrastructure in the coming two decades. In addition to strains that such an expansion would place on the safety and regulatory structure, a large expansion such as that envisioned by Pakistan's nuclear authorities might require the recruitment of an additional 18,000 trained personnel over the next twenty years. Braun is worried of the ability of Pakistani institutions to adequately train such large numbers and also expresses concern that such a large pool of individuals could be infiltrated by saboteurs or terrorists.<sup>100</sup> In the event of internal military conflict—perhaps a coup attempt by low-level officers—Braun hypothesizes that nuclear reactors might be attractive targets for rebel military forces.<sup>101</sup>

Braun may overstate the attractiveness of a reactor for rebel military troops. Even assuming the forces were able to capture KANUPP for instance, which might have near weapons-grade plutonium on site, the ability to reprocess it, turn it into a usable device, and then develop means to deliver it to a target would be a complicated and time-consuming process, one which the international community is unlikely to allow to unfold. Rebels could use the plant or the materials at the plant to create some sort of radioactive incident, but military rebels are primarily concerned with legitimacy, and irradiating thousands of Pakistanis does not seem likely to achieve that effect. Even for religious radicals, creating a radioactive incident that has the principal affect of irradiating other Muslims does not seem to achieve either political or eschatological ends.

More broadly, some commentators have expressed concerns over the vulnerability of radioactive sources to terrorist seizure. The concern is that terrorists with such material could then create a radiological dispersal device (RDD), or “dirty bomb.” While this threat should not be ignored, Pakistan does not necessarily pose any special risk over and above other countries. The multitude of radiological sources globally is the principal challenge for any government attempting to secure them all against a determined foe. In 2004, over 370 radiological sources were lost in the

United States and European Union on an annual basis. Thousands have been lost from countries in the former Soviet Union.<sup>102</sup> According to a 1998 Bhabha Atomic Research Centre study, there were nearly 10,000 radioactive sources in India. In India, some of these radioactive sources have been stolen and in at least 13 cases the material was never recovered.<sup>103</sup> The Pakistan Nuclear Regulatory Authority is aware of the threat posed by radioactive material and employs regulatory and engineering controls over radioactive sources through licensing and monitoring from the time they are imported until they are disposed, including periodic physical inspections.<sup>104</sup>

### **Pakistan's Nuclear Security during Conflict**

The issue of whether or not intentional nuclear use is likely in an Indo-Pakistani war is beyond the scope of this paper. This paper also does not seek to assess the risks involved with an Indian limited war, involving the Cold Start doctrine or any other operational or doctrinal innovation. This section instead has a more limited objective of seeking to discuss changes in nuclear risk in Pakistan caused by the increased nuclear readiness likely associated with another Indo-Pakistani conflict.

As discussed earlier, during deep crisis or conventional conflict with India, Pakistan relies upon road-mobility of its land-based assets to protect them against Indian counterforce strikes.<sup>105</sup> During the 2001-2002 military standoff with India, Kidwai famously speculated on what Pakistan's redlines might be in a conflict with India: "Nuclear weapons are aimed solely at India. In case that deterrence fails, they will be used if

- a. India attacks Pakistan and conquers a large part of its territory [space threshold]
- b. India destroys a large part either of its land or air forces [military threshold]
- c. India proceeds to the economic strangling of Pakistan [economic strangling]
- d. India pushes Pakistan into political destabilisation or creates a large scale internal subversion in Pakistan [domestic destabilisation]."<sup>106</sup>

While former SPD officials have gone to great lengths to stress that this was an academic exercise and not an attempt at nuclear signalling—they note that Kidwai's remarks to the visiting Italian team were supposed to be "off-the-record" under the ground rules for the interview—these four scenarios are Pakistan's plausible redlines.<sup>107</sup> As they are approached,

it is reasonable to expect Pakistan to increase the readiness of its strategic forces. Mobile units would be dispersed and, either in the field or prior to dispersal, weapons would be mated with delivery vehicles. During this movement, there would be a number of attendant dangers not present in Pakistan's peacetime posture.

First, there is a modest increase in the risk of an accident. Pakistani road infrastructure is poor and traffic is horrible. For liquid-fueled missiles, the mobile platform would have to be accompanied by the highly flammable fuel. It seems likely that mobile launchers would be sent away from the forward edge of battle, meaning they would most likely be sharing the road with internally displaced people also moving away from combat. All of this contributes to the potential for accident in transport. Another source of nuclear risk might include Indian air force strikes against Pakistani air force bases, where nuclear weapons may be stored. Though quite unlikely, such events—accidents or military action—could lead to accidental detonation, or less severe incidents involving the dispersal of radioactive material.<sup>108</sup> As discussed previously, this likelihood is raised by the paucity of Pakistani nuclear tests.

Second, maintaining a communications link between the mobile launcher and the National Command Authority may prove difficult.<sup>109</sup> These difficulties are only compounded during conventional war. While Indian Air Force targeting doctrine during a conflict with Pakistan is not clear, it seems likely that India will target command and control nodes aggressively. In the event of communications breakdown, has Pakistan designed a system that will fail-safe (and be unusable) or a system that allows the local commander some predelegated authority in such situations? The previous discussion of PALs is important here, because if there are technical mechanisms that prevent launch without validated authorization from the NCA, predelegated authority cannot exist. If however, there are only procedural requirements, such as a two-man rule, then a local commander could still take action *in extremis* to launch his weapon, if he believed nuclear redlines had been crossed. Former SPD official Khan was so struck by the logic of this argument, he concluded some sort of predelegated authority must exist: "The only possible way to assure stability in the absence of sophisticated positive and negative controls is by adopting a policy of assured destruction—i.e., a policy giving local commanders the authority to launch nuclear weapons at times of extreme jeopardy to conventional forces. Custodians of dispersed weapons must therefore be technically self-sufficient and capable of launch even if orders from the NCA are not received."<sup>110</sup>

While SPD views and Pakistani technical capabilities likely have evolved since Khan wrote that article in 2003, Khan's argument should give pause to those who argue that unauthorized launch is impossible.

Third, there has been some concern about the security of mobile nuclear units, when they are away from the static and reinforced security provided at a fixed storage site.<sup>111</sup> This concern seems overblown. Any mobile launcher is likely to be accompanied by a large security team. Further, intercepting a mobile launcher requires a good deal of luck, whereas attacking a fixed facility can be planned. American academic Jordan Seng concluded, "Just as it is hard to hit what cannot be seen, it is hard to steal what cannot be found."<sup>112</sup>

Pakistan benefits from such a modest increase in nuclear risk in the midst of conventional conflict. It might be quite difficult for Pakistan as a fully rational actor to make the monumental (and ultimately suicidal) decision to initiate nuclear use against India. To the extent, however, that risk increases during the course of a conflict and such risk is not completely under the control of central policymakers, this reinforces Pakistan's deterrence efforts. These are "threats that leave something to chance," to use the term coined by Thomas Shelling during the Cold War. Here, the most critical question is whether commanders of individual nuclear units either have the authority or the technical ability to launch weapons if they believe Pakistan's nuclear redlines have been crossed. There is insufficient information today to definitively conclude one way or the other on this matter.

### **Pakistan's Nuclear Security during Widespread Domestic Instability**

The other contingency that could place systemic stress on Pakistan's command and control system is widespread domestic instability. Distinguishing between different types of instability can assist with thinking about associated nuclear risks. The most extreme form of risk would be takeover of the state by radical Islamists, a scenario that Bruce Riedel has documented at some length.<sup>113</sup> While the Islamist Pakistan that Riedel describes is disturbing, neither Riedel nor other analysts have a convincing narrative of how the Pakistan of today gets there. As the Taliban began to push into northern Punjab in 2009, public antipathy to the movement became clearer and, along with US pressure, forced the Pakistan Army to launch concerted and sustained military operations. Through all of the most populace regions of Pakistan, there is little evidence that anything close to a majority support Islamists. In no Pakistani election have Islamists garnered more than 11 per cent of the vote and the 2002 elections, the

year when Islamist parties did best, were unique because of the degree of anti-US sentiment as well as procedural rulings that favoured religious parties over mainstream parties.<sup>114</sup> In other words, this is not revolutionary Iran.

The second concern is that an internal coup within the Pakistan Army would result in Islamist officers overthrowing the more moderate current Army leadership.<sup>115</sup> This is one route by which one can imagine an Islamist Pakistan despite the fact there is not majority support for such regime. While this scenario is difficult to discount completely, there has never been a successful coup within the Pakistan Army of lower-level officers against top Army leadership. Moreover, while there is a rising generation of officers recruited and first groomed during the much more conservative reign of President Gen. Zia-ul-Haq, the last three Army chiefs (Karamat, Musharraf, and Kayani) have all been moderates. Army chiefs actively scrutinize the promotion of senior and important officers. It seems improbable that a closet fundamentalist could have risen to a position of much influence after twelve years of moderate chiefs, particularly given Pakistan's robust internal intelligence apparatus.

The third concern, which is more plausible, is that there might be an internal coup attempt or some sort of lower-level fracturing within the Pakistani officer corp. Lower-level officers of an Islamist bent, perhaps together or separately with Pashtun ethnicity officers, angered by support to the United States or Pakistan's operations along the Pakistan-Afghanistan border might be able to launch a successful, localised mutiny. In terms of insider threats to the arsenal, ideally the personnel reliability programme should screen out such individuals from gaining entry into the strategic forces themselves, though there is always some risk of failure. If zealots or mutineers served within Pakistan's strategic weapons complex, only procedural and technical safeguards would contain nuclear risk. As for outsider threats, if a group gained localised control of territory during a mutiny, the secrecy of Pakistan's nuclear storage sites, even within the Pakistani armed forces, means it is unlikely they would even be aware of a nuclear site in their vicinity. Additionally, a localised splinter group attempting to take a nuclear facility would have to be large enough to overpower the SPD security division personnel guarding the site.

The fourth scenario, which is more plausible, is that the Pakistani state faces a sudden loss of territory to a separatist or Islamist movement outside of Punjab, such as the rapid loss of control over Baluchistan or Northwest Frontier Province. State institutions are weak in these provinces and popular support for such a movement cannot be discounted.

However, precisely because of the predictability of that risk, the Pakistani state might decide only to store sensitive nuclear materials in or near the Punjabi heartland. Even for facilities in Baluchistan or NWFP, such a scenario would require both the Pakistani state to have no strategic warning about growing instability in a region as well as for the local movement to be sufficiently large to overwhelm SPD's security division personnel before nuclear devices could be removed.

The fifth scenario is some sort of sudden, multifaceted state collapse. Here, to borrow from Mark Twain, rumours of Pakistan's death have been greatly exaggerated. The Pakistani state has profound challenges that jeopardise not just Pakistan but the planet, but state failure is still quite rare in the international system. In Adam Smith's phrase, there is a "great deal of ruin in a nation," and while Pakistan has suffered much, it seems likely to endure. Anatol Lieven, writing from Karachi, observes:

Karachi demonstrates as well as anywhere else the fact that while Pakistan is a troubled state, it is as yet very far from being a failed one. Only in its north-western fringe has state power collapsed—and state power there wasn't always very real anyway. Calling Pakistan a failed state is a bit like saying that Russia has failed as a state because it has lost control of parts of the northern Caucasus. Anyone who, like me, has lived and worked in truly failed states will know the difference immediately. Cities in failed states do not have Karachi's great industries, road and sewage networks that have improved radically in recent years, a clean, well-functioning modern airport, or a highly effective—if rather ruthless—municipal administration.<sup>116</sup>

The current Pakistan command and control arrangement appears to be designed to confront most plausible scenarios with regards to domestic instability in Pakistan. While the international system should continue efforts to stabilise Pakistan—in part so that scenarios that currently seem implausible do not become more likely—analysts looking at Pakistani nuclear risk should not assume state failure. The next section explores the consequences of a Pakistani state that is likely to muddle through.

## **Policy Recommendations and Conclusion**

The above analysis indicates that the Pakistani state has taken significant efforts to secure its nuclear arsenal from insider and outsider threats. While nuclear risk does rise appreciably in the context of both conventional conflict with India or widespread domestic instability within Pakistan, the most plausible scenarios of those events seem to indicate a manageable level of nuclear risk. Further, while it is not the focus of this paper, an important analytical conclusion is that the likelihood of a jihadist takeover of the Pakistani state is small. If either the Pakistani state were near



collapse or ripe for an Islamist regime, then policymakers in Delhi and Washington, DC would be prudent to focus on those worst-case scenarios. If such dire scenarios were probable, then the focus of Indian or American efforts would be on how to manage them. Should America consider plans to takeover Pakistan's arsenal? Should India robustly build missile defences to prepare for a radical regime in its neighbour? The above analysis indicates, however, that the bulk of American and Indian planning should be on shaping Pakistan so that the direst scenarios do not come to pass.

Delhi and Washington DC disagree on the best policy to moderate Pakistani behaviour and hence inoculate Pakistan from chronic domestic instability. Washington prefers engagement and tough love, while Delhi prefers stern messages and containment. While I am more sympathetic to the US approach, this is not an appropriate forum to attempt to resolve this long-running disagreement. Instead, there are several more modest recommendations for policymakers in the United States and India.

At the international level, progress on the Fissile Material Cutoff Treaty (FMCT) is likely the only measure that can stop the growth of weapons stockpiles in Pakistan (or India). Such a measure will be viewed as much less hypocritical in Islamabad than attempts to subject Pakistan alone to pressure to stop arsenal growth. Pressure on Pakistan to stop fissile material production unilaterally is likely to be counterproductive. There are many in Pakistan who believe that the United States is out to take away Pakistan's nuclear weapons through whatever means necessary. Unilateral pressure reinforces their position in internal debates, and likely would correlate with less Pakistani assistance across the board on other nonproliferation issues as well as reduced US-Pakistan practical cooperation to secure nuclear sites.

Already, Pakistan has halted progress at the Conference on Disarmament on the FMCT, in part to demonstrate Pakistani displeasure at the US-India civil nuclear cooperation initiative that Pakistan believes will facilitate Indian fissile material production.<sup>117</sup> The stated concerns are largely about parity of Pakistani and Indian stockpiles. Hawkish Pakistani analyst Shireen Mazari captures this concern, “[I]f there are no provisions for reductions in existing stockpiles of fissile material, it will be at a permanent disadvantage in terms of its nuclear deterrence vis-à-vis India.”<sup>118</sup> Neither Mazari nor other Pakistan analysts explain how an Indian advantage in fissile material translates into any erosion into Pakistani deterrence. Given countervalue targeting—reinforced by the incredible



difficulty of either country being able to launch a counterforce strike with existing weapons numbers—parity is irrelevant. More importantly, if fissile material production is unconstrained, India has tremendous economic and technological advantages that will allow it to outpace Pakistan. Indian and Pakistani analysts both worry that the FMCT will give the other party the upper hand.<sup>119</sup> Both cannot be right. The difficult verification issues surrounding the FMCT—here, too, writings from both Delhi and Islamabad strongly caution that verification is necessary to prevent the perfidious neighbour from evading a cut-off—mean that any measure is years away at the earliest. Policymakers will need to take other moderating steps until then.

For India, Delhi must take into greater account likely Pakistani reactions to its technical decisions. In particular, efforts to improve the accuracy of nuclear-capable missiles and programmes to develop missile defences appear to be occurring without political guidance. New Delhi is not just a passive recipient of Pakistan's nuclear decisions. Pakistan factors in both counterforce risk and missile defence attrition into sizing its nuclear arsenal. It is important for Indian decision-makers not to mirror-image onto their Pakistani counterparts. Pakistani strategic policymakers, almost all of who are military officers, do not believe that nuclear deterrence is an easy thing to achieve or that it arises immediately out of the existence of nuclear weapons. They have internalised the US Cold War literature on nuclear weapons far more than Indian strategic elites. That literature said that deterrence is difficult and requires constant attention to the offence-defence balance. If India is serious about missile defence and has a clear strategic vision about how defences factor into the broader strategic equation, then pursuit of the programme may make sense. Pursuing the programme to placate Defence Research and Development Organisation (DRDO) scientists is not a good enough reason. If Delhi decides to pursue a limited ballistic missile defence, perhaps to reduce the dangers associated with unauthorised or accidental launch, it would be prudent to discuss this with Pakistan, and perhaps dampen the inevitable Pakistani strategic responses.

DRDO scientists periodically mention their success in improving the precision of India's conventional ballistic missiles. Accuracy is troublesome for nuclear stability because it makes first strikes easier. There may be marginal military utility in having more precise ballistic missiles, but it seems like that benefit will be more than obviated by the disadvantages. Pakistani nuclear planners have always been sceptical of India's no-first use pledge and are constantly on the lookout for evidence that it is hollow.

If they come to believe that Indian first use is likely, they may very well increase the size and readiness of the arsenal, increasing the risks that things could get out of hand in a crisis. Precision strike is even more worrisome when paired with missile defence developments. No matter how secure Pakistan's arsenal, more weapons increase the chance of accident, theft, loss, or other incident. Further, concerns about counterforce strike could lead Pakistan to maintain its force (or a portion of the force) at higher states of readiness, which would also lead to greater risks.

For the United States, officials must take into account Pakistani reactions to US discussions about Islamabad's nuclear stewardship. In public, US officials generally have taken the right tone. They have acknowledged the importance of the problem, they have stated that the United States and Pakistan are working together to ameliorate risks, and they have stated their assessment that the risks are manageable. The steady stream of anonymous quotes about US fears—particularly discussions about whether or not there are US plans to secure Pakistani nuclear weapons in a worst-case scenario—are remarkably unhelpful. They discourage cooperation between the United States and Pakistan to confront the problem together and they make Pakistani officials question US motives. To some extent, this is unavoidable. Journalists will call serving and retired US officials until they find the quotes that drive their narrative forward. If such anonymous quotes had any tangible benefit they might be justifiable. Leaks can arguably play a useful role in order to highlight an unexamined issue or to advocate for a policy. In this case, the highest officials of the Bush and Obama administration have publicly and privately demonstrated they are aware of the problem and take it seriously. Moreover, there is no evidence that the leakers have a coherent alternative strategy they would like the Obama administration to pursue. Whether or not private planning for worst-case scenarios is justified, public discussion of such planning is not justified. Michael Krepon of the Henry L. Stimson Center has argued, "I think these plans—if they exist and I'm not sure that they do—[are] unlikely to be successfully executed and would result in multiple mushroom clouds," Krepon said. "So I think this is a bad idea, and I think it's a bad idea even to talk about it."<sup>120</sup> The leaks have clear costs for US interests with no tangible benefits. The Obama administration will not be able to stop the leaks, but it should continue to strike a public tone that lauds Pakistan for the work done to make the arsenal safer.

Frequently, any article on Pakistan's nuclear security includes a discussion on the pros and cons of providing Pakistan permissive action links.<sup>121</sup> The combination of Pakistani scepticism and legal and technical objections makes this debate largely academic. Unless the US Government could obviate Pakistani concerns of US "kill" switches, Pakistan would reject any proposals, as it may have already done in the past. Further, providing PAL technology is useful only to the extent it could prevent the launch or use of mated warheads. As discussed above, there are strong indications that Pakistan employs PAL-like code locks already, which may be sufficient for warhead security in peacetime. It seems likely that transferring PALs that would prevent assembled and mated warheads from detonating would require some combination of Pakistani willingness to share weapons designs and US willingness to modify those designs in a way that permitted embedded PALs. The legal, technical, and trust hurdles are likely insurmountable.

At the end of the day, then, there are scant policy options. The few that are offered here do not fundamentally change the risks. While this article has argued that Pakistan's weaknesses have been exaggerated and its instability overblown, that does not justify relaxation. Constant vigilance will be required from policymakers in Islamabad, Rawalpindi, and elsewhere to ensure that Pakistan's nuclear programme remains secure. Fundamentally, this security task is inseparable from the task of stabilising Pakistan. Pakistan may have nuclear security measures as effective as any other nuclear power, but those nuclear weapons face greater risks than those in almost any other nuclear state. The policy options presented above might lower the number of nuclear warheads and, as a consequence, lower nuclear risk. But the true source of nuclear risk in Pakistan is the insecurity of Pakistan. Reducing that instability must be the focus of decision-makers in Islamabad, Washington, and Delhi.

## End notes

- <sup>1</sup> David E. Sanger, "Pakistan Overshadows Afghanistan on US Agenda," *New York Times*, May 6, 2009. Riedel presented his vision of the likely consequences of a jihadist-controlled Pakistani state in Bruce Riedel, "Armageddon in Islamabad," *The National Interest*, July-August 2009.
- <sup>2</sup> David E. Sanger, "What to Do about Pakistan's Nuclear Arsenal?" *New York Times Magazine*, January 8, 2009.
- <sup>3</sup> See, for instance, National Security Presidential Directive-17/Homeland Security Presidential Directive-4, unclassified version, "National Strategy to Combat Weapons of Mass Destruction," December 2002, available at [www.fas.org/irp/offdocs/nspd/nspd-17.html](http://www.fas.org/irp/offdocs/nspd/nspd-17.html).
- <sup>4</sup> Carlos Lozada, "A Conversation with David Kilcullen," *Washington Post*, March 22, 2009.
- <sup>5</sup> Paul McGeough, "Warning that Pakistan Is in Danger of Collapse within Months," *Sydney Morning Herald*, April 13, 2009.
- <sup>6</sup> Sanger, no. 1
- <sup>7</sup> Leonard Weiss, "Pakistan: It's Déjà Vu All over Again," *Bulletin of the Atomic Scientists* 60, no. 3, May/June 2004, 52.
- <sup>8</sup> Bryan Bender, "Pakistan, US in Talks on Nuclear Security," *Boston Globe*, May 5, 2009.
- <sup>9</sup> Admiral Michael Mullen, "Defense Department Briefing Transcript," *Federal News Service*, May 4, 2009. Also see Admiral Michael Mullen, "Remarks to the L.A. World Affairs Council," *Federal News Service*, September 22, 2008.
- <sup>10</sup> General David Petraeus, "Interview with Chris Wallace," *Fox News Sunday*, May 10, 2009.
- <sup>11</sup> Jon Meacham, "A Highly Logical Approach: A Conversation with Barack Obama," *Newsweek*, May 16, 2009, <http://www.newsweek.com/id/197891>.
- <sup>12</sup> One of the most comprehensive examinations of the topic is Paul K. Kerr and Mary Beth Nikitin, "Pakistan's Nuclear Weapons: Proliferation and Security Issues," *CRS Report for Congress*, no. RL34248, Washington, DC: Congressional Research Service, updated February 23, 2010. Kerr and Nikitin are particularly good at collating public statements by government officials. Henry D. Sokolski's edited volume addresses many issues surrounding Pakistan's nuclear security. Sokolski, ed., *Pakistan's Nuclear Future: Worries Beyond War* (Carlisle, Penn.: Strategic Studies Institute, US Army War College, January 2008). Also see Shaun Gregory, "The Terrorist Threat to Pakistan's Nuclear Weapons," *Counter Terrorism Center Sentinel* 2, no. 7, July 2009, 1-4 and Reshmi Kazi, "Pakistan's HEU-Based Nuclear Weapons Programme and Nuclear Terrorism: A Reality Check," *Strategic Analysis* New Delhi, November 2009.
- <sup>13</sup> This essay uses the term "nuclear weapons states" without any legal baggage. I use the term to mean a state that possesses a nuclear explosive device that can be delivered onto an adversary's territory.
- <sup>14</sup> Harold A. Feiveson, "Finite Deterrence," in Henry Shue, ed., *Nuclear Deterrence and Moral Restraint*, Cambridge University Press, New York, 1989, chapter 6.
- <sup>15</sup> During my tenure at the Henry L. Stimson Center and the Naval Postgraduate School, I had the privilege of regularly interacting with retired and serving Pakistani military officials involved in nuclear planning. Many of these conversations were informal discussions rather than formal interviews, and hence citation is problematic. Whenever I say that Pakistani strategic planners "do" something, this is directly based on conversations with them. Whenever I say that Pakistani strategic planners "might" do something, this is an inference on my part and is not directly from my conversations with them. To the extent possible, I will attempt to cite written sources when they exist.
- <sup>16</sup> Airbursts, rather than ground-bursts, would cause the largest number of civilian casualties.
- <sup>17</sup> This seems a reasonable assumption, though I have not heard Pakistani serving or retired military officials discuss this particular element in nuclear planning.

- <sup>18</sup> On the issue of nuclear first strike, Peter R. Lavoy states that a key element of Pakistan's strategic deterrence strategy is "a survivable strategic force capable of withstanding sabotage, conventional military attacks, and at least one enemy nuclear strike...." Lavoy, "Islamabad's Nuclear Posture: Its Premises and Implementation," in Sokolski, ed., *Pakistan's Nuclear Future*, pp. 131, 159. Lt. Gen. Khalid Kidwai, head of the Strategic Plans Division, listed "ability to deter a counterstrike against strategic assets" as an objective of Pakistan's nuclear policy. Robin Walker, summary of "Pakistan's Evolution as a Nuclear Weapons State: Lt. Gen. Khalid Kidwai's CCC Address," US Naval Postgraduate School, November 1, 2006, <http://www.ccc.nps.navy.mil/news/kidwai/nov06.asp>.
- <sup>19</sup> Similarly, Bharat Karnad noted that the Indian National Security Advisory Board sought to "elasticize" the concept of minimum deterrence by adding the requirement that it must be credible in their draft nuclear doctrine of August 2009. See Karnad, *India's Nuclear Policy*, Praeger Security, Westport, Conn., 2008, p.85.
- <sup>20</sup> Zia Mian and A. H. Nayyar, "Pakistan," in *Banning the Production of Fissile Materials for Nuclear Weapons: Country Perspectives on the Challenges to a Fissile Material (Cutoff) Treaty*, International Panel on Fissile Materials, 2008, p.196, available at [www.ipfmlibrary.org/gfmr08cv.pdf](http://www.ipfmlibrary.org/gfmr08cv.pdf).
- <sup>21</sup> Robert S. Norris and Hans Kristensen, "Nuclear Notebook: Pakistan Nuclear Forces, 2009," *Bulletin of the Atomic Scientists* September-October 2009, p.82.
- <sup>22</sup> Thom Shankar and David E. Sanger, "Pakistan is Rapidly Adding Nuclear Arms, US Says," *New York Times*, May 18, 2009 and Bender, "Pakistan, US in Talks on Nuclear Security."
- <sup>23</sup> Zia Mian, et al, *Fissile Materials in South Asia: The Implications of the US-India Nuclear Deal* (International Panel on Fissile Materials, September 2006), 14-15, available at [http://www.fissilematerials.org/ipfm/site\\_down/rr01.pdf](http://www.fissilematerials.org/ipfm/site_down/rr01.pdf).
- <sup>24</sup> The IPFM report does not directly argue against ISIS's estimate, but assumes the new Khushab reactors have a generating capacity approximately equal to the existing Khushab reactor of 40-50MWth, whereas the ISIS estimate was as high as 1,000MWth. NRDC expert Thomas Cochran has explicitly argued against the analysis, judging that ISIS misinterpreted satellite imagery of the reactor construction site. Cochran estimates the new reactors will have capacities greater than 40MWth, but no more than 100MWth. See Thomas B. Cochran, "What Is the Size of Khushab II?" Natural Resources Defense Council, Washington, DC, September 8, 2006, [http://docs.nrdc.org/nuclear/nuc\\_06090801A.pdf](http://docs.nrdc.org/nuclear/nuc_06090801A.pdf).
- <sup>25</sup> For ISIS's analysis see David Albright and Paul Brannan, "Commercial Satellite Imagery Suggests Pakistan is Building a Second, Much Larger Plutonium Production Reactor: Is South Asia Headed for a Dramatic Buildup in Nuclear Arsenals?" *ISIS Report*, ISIS, Washington, DC, July 24, 2006, <http://isis-online.org/publications/southasia/newkhushab.pdf>; Albright and Brannan, "Further Discussion of the New, Large Khushab Reactor", <http://isis-online.org/publications/southasia/khushabdiscussion2.pdf> August 4, 2006; and Albright and Brannan, "Update on the Construction of the New, Large Khushab Reactor", <http://www.isis-online.org/publications/southasia/khushabupdate.pdf>, October 4, 2006. For US Government reactions, see William J. Broad and David E. Sanger, "US Disputes Reports on New Pakistan Reactor," *New York Times*, August 3, 2006 and Shahzeb Jillani, "Pakistan Nuclear Report Disputed," *BBC News*, August 7, 2006. Jillani quotes a US State Department spokesperson as saying "the reactor will be over ten times less capable" than ISIS's estimates.
- <sup>26</sup> Albright and Brannan, "Commercial Satellite Imagery Suggests....," p. 4 and *Global Fissile Material Report 2008: Scope and Verification of the Fissile Material (Cutoff) Treaty*, International Panel on Fissile Materials, 2008, pp. 12-13, available at [http://www.fissilematerials.org/ipfm/site\\_down/gfmr08.pdf](http://www.fissilematerials.org/ipfm/site_down/gfmr08.pdf).
- <sup>27</sup> Mian, et al, *Fissile Materials in South Asia*, p. 15; also see Department of Commerce, Bureau of Export Administration, "15 CFR Parts 742 and 744: India and Pakistan Sanctions and Other Measures; Interim Rule," *Federal Register* November 19, 1998, available at <http://www.fas.org/nuke/control/export/news/ENTnov19.pdf>.

- <sup>28</sup> Mark Hibbs, "Pakistan Developed More Powerful Centrifuges," *Nuclear Fuel*, January 29, 2007; also see Mark Hibbs, "P-4 Raised Intelligence Concerns about Post-1975 Data Theft," *Nucleonics Week*, February 15, 2007.
- <sup>29</sup> The IPFM estimate assumes 120 kg of HEU were consumed in the six declared nuclear weapons tests in 1998. See Mian, et al, *Fissile Materials in South Asia*, p. 15; and *Global Fissile Material Report 2008: Scope and Verification of the Fissile Material (Cutoff) Treaty*, pp. 12-13.
- <sup>30</sup> *Global Fissile Material Report 2008: Scope and Verification of the Fissile Material (Cutoff) Treaty*, 12.
- <sup>31</sup> Ibid, pp. 111-112, fn 30. Also see Mark Hibbs and Shahid-ur-Rehman, "Pakistan Civilian Fuel Cycle Plan Linked to NSG Trade Exemption," *Nuclear Fuel*, August 27, 2007.
- <sup>32</sup> Cochran, "What is the Size of Khushab II?" p. 18.
- <sup>33</sup> Nuclear-capable cruise missiles likely would require some degree of miniaturisation of the warhead. See Norris and Kristensen, "Nuclear Notebook: Pakistan Nuclear Forces, 2009."
- <sup>34</sup> Former Pakistan Strategic Plans Division official Feroz Hassan Khan mentions "missile silos" in passing in Khan, "Nuclear Security in Pakistan: Separating Myth from Reality," *Arms Control Today*, July-August 2009. A *Washington Times* report in January 2002 was misinterpreted in at least one Indian press outlet as saying US intelligence had evidence that Pakistan was constructing silos for M-11 missiles near the border. However, the original story said instead, "launch-site construction was described as concrete areas where mobile missile launchers will be stationed..." See Bill Gertz, "Pakistan Builds Missile Sites Near Border with India," *Washington Times*, January 14, 2002 and the erroneous report from the *Press Trust of India*, "Pakistan Constructing Missile Silos Near Indian Border: Report," *rediff.com*, January 14, 2002.
- <sup>35</sup> The table is illustrative only. It draws primarily from US National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat*, Wright-Patterson Air Force Base, Ohio, April 2009, available at [www.fas.org/programmes/ssp/nukes/nasic2009.pdf](http://www.fas.org/programmes/ssp/nukes/nasic2009.pdf). When the NASIC report does not report a figure, the table draws from Peter R. Lavoy, "Fighting Terrorism, Avoiding War: The Indo-Pakistani Situation," *Joint Force Quarterly*, no. 32, Autumn 2002, p. 34. Lavoy distinguishes between Ghauri 1 and Ghauri 2, while NASIC does not. NASIC also does not discuss the Abdali (Hatf-2). For F-16 and Mirage-5 numbers, I have used "Pakistan F-16," *Globalsecurity.org*, [www.globalsecurity.org/military/world/pakistan/f-16.htm](http://www.globalsecurity.org/military/world/pakistan/f-16.htm) and Lavoy, respectively.
- <sup>36</sup> Quoted in "No Possibility of Nuke War: Musharraf," *Rediff.com*, [www.rediff.com/news/2003/jan/10pak1.htm](http://www.rediff.com/news/2003/jan/10pak1.htm), January 10, 2003.
- <sup>37</sup> A brief overview of the open sources concluding warheads are or are not disassembled can be found at Kerr and Nikitin, "Pakistan's Nuclear Weapons," p. 10.
- <sup>38</sup> Office of the Secretary of Defense, *Proliferation: Threat and Response*, GPO, Washington, DC, January 2001, p. 27.
- <sup>39</sup> Ashley Tellis testimony, "US-Pakistan Relations: Assassination, Instability, and the Future of US Policy," Hearing of the Middle East and South Asia Subcommittee of the House Foreign Affairs Committee, January 16, 2008.
- <sup>40</sup> Nicholas Kralev and Barbara Slavin, "Clinton Warns of Pakistan Nuke Risk," *Washington Times*, April 24, 2009.
- <sup>41</sup> David Sanger, "So, What about Those Nukes?" *New York Times*, November 11, 2007.
- <sup>42</sup> George Jahn, "Analysis: Infiltration Greatest Pakistan Nuke Risk," *Associated Press*, May 5, 2009. Jahn may be referencing without attribution a paper by Kenneth N. Luongo and Brig. (Retd.) Naeem Salik, "Building Confidence in Pakistan's Nuclear Security," *Arms Control Today*, December 2007, which references reports of six storage sites. The Luongo and Salik piece, however, references a paper by David Albright, which while referencing six *types* of facilities, does not say there are just six facilities. Instead, Albright says, "Pakistan is reported to have several nuclear weapons storage facilities."

Their exact locations are unknown.” Albright, “Securing Pakistan’s Nuclear Weapons Complex,” paper presented at the Stanley Foundation 42<sup>nd</sup> Strategy for Peace Conference, Warrenton, Virginia, October 25-27, 2001, <http://www.isis-online.org/publications/terrorism/stanleypaper.html>. A late 2001 article refers to dispersing Pakistani nuclear assets to six sites. Molly Moore and Kamran Khan, “Pakistan Moves Nuclear Weapons: Musharraf Says Arsenal Is Now Secure,” *Washington Post*, November 11, 2001.

- <sup>43</sup> Various discussions with SPD officials (in particular in Rawalpindi, December 2005); also see Sanger, “What to Do about Pakistan’s Nuclear Arsenal?” and Kenneth N. Luongo and Brig. (Retd.) Naeem Salik, “Building Confidence in Pakistan’s Nuclear Security,” *Arms Control Today*, December 2007.
- <sup>44</sup> “Musharraf Reappoints Kidwai,” *Daily Times*, October 7, 2007, [www.dailytimes.com.pk/default.asp?page=2007\10\07\story\\_7-10-2007\\_pg7\\_22](http://www.dailytimes.com.pk/default.asp?page=2007\10\07\story_7-10-2007_pg7_22).
- <sup>45</sup> Figure is adapted from Air Cmde Khalid Banuri, “Nuclear Command and Control in Pakistan,” Presentation at the Naval Postgraduate School, July 1, 2004; also see Lavoy, “Islamabad’s Nuclear Posture,” p. 151. Banuri’s original graphic included the President as Chairman with Prime Minister as Vice-Chairman. When President Zardari removed himself from the National Command Authority in 2009, the Prime Minister was elevated to Chairman and the Vice-Chairman position was abolished. See discussion in Kerr and Nikitin, “Pakistan’s Nuclear Weapons,” p. 9, fn. 51.
- <sup>46</sup> Luongo and Salik, “Building Confidence in Pakistan’s Nuclear Security.” Salik, a former E&R cell and SPD official, can be taken as a definitive source on these matters and his description matches those I have received in other conversations with SPD officials. Also see Lavoy, “Islamabad’s Nuclear Posture,” pp. 152-3.
- <sup>47</sup> Source for figure is Banuri, “Nuclear Command and Control in Pakistan”; also see Lavoy, “Islamabad’s Nuclear Posture,” p. 153. This figure is somewhat simplified, leaving out two small organisations that report to the Director-General, SPD.
- <sup>48</sup> Luongo and Salik, no. 46
- <sup>49</sup> Rolf Mowatt-Larssen, “Nuclear Security in Pakistan: Reducing the Risks of Nuclear Terrorism,” *Arms Control Today* (July-August 2009).
- <sup>50</sup> Luongo and Salik, no. 46
- <sup>51</sup> Lavoy, “Islamabad’s Nuclear Posture,” p. 152.
- <sup>52</sup> “Nuclear safety, nuclear stability and nuclear strategy in Pakistan,” Landau Network, Centro Volta, Como, Italy, January 2002, <http://lxmi.mi.infn.it/~landnet/Doc/pakistan.pdf>.
- <sup>53</sup> Both former SPD officials Brig. (Retd.) Feroz Hassan Khan and Brig. (Retd.) Naeem Salik state that the screening programmes apply to “all officials.” Khan, “Pakistan’s Nuclear Security,” and Luongo and Salik, “Building Confidence in Pakistan’s Nuclear Security.”
- <sup>54</sup> Sanger, “What to Do about Pakistan’s Nuclear Arsenal?” Given the large number of people working “in the nuclear complex” it seems reasonable that only a much smaller subset with access to sensitive material are subject to the HRP or PRP.
- <sup>55</sup> Sanger, no. 54
- <sup>56</sup> Luongo and Salik stress this as an area for additional effort. Luongo and Salik, “Building Confidence in Pakistan’s Nuclear Security.”
- <sup>57</sup> Douglas Frantz and David Rohde, “2 Pakistanis Linked to Papers on Anthrax Weapons,” *New York Times*, November 28, 2001; and Mowatt-Larssen, “Nuclear Security in Pakistan.” There is insufficient information to assess the bizarre case of Suleiman Assad and Mohammed Muktar, two Pakistani scientists who reportedly travelled to Burma shortly after September 11, 2001 and may have had prior contacts with the Taliban or Al Qaeda. See Douglas Frantz, James Risen, and David E. Sanger, “Nuclear Experts in Pakistan May Have Links to Al Qaeda,” *New York Times*, December 9, 2001 and *Press Trust of India*, “Myanmar Gives Sanctuary to Pak Nuke Scientists,” *The Indian Express*, November 23, 2001.



- <sup>58</sup> Joby Warrick, "Pakistan Nuclear Security Questioned," *Washington Post*, November 11, 2007.
- <sup>59</sup> Khan, "Nuclear Security in Pakistan"; also see Luongo and Salik, "Building Confidence in Pakistan's Nuclear Security." Whether material was lost prior to more rigorous MPC&A practices may never be known. See Pervez Hoodbhoy, "A State of Denial: Pakistan's Nuclear Threat," *International Herald Tribune*, January 17, 2008.
- <sup>60</sup> Kidwai quoted in Walker, summary of "Pakistan's Evolution as a Nuclear Weapons State." Also see reference to what Sanger calls "Pak-PALs" in Sanger, "What to Do about Pakistan's Nuclear Arsenal?"
- <sup>61</sup> Feroz Hassan Khan has seemed to elude more towards a two-man rule, with a military and a technical official having to approve. Khan quoted in Martin Schram, *Avoiding Armageddon: Our Future, Our Choice*, Basic Books, New York, 2003, p. 54.
- <sup>62</sup> Luongo and Salik, no. 46
- <sup>63</sup> Khalid Banuri and Adil Sultan, "Managing and Securing the Bomb," *DailyTimes*, May 13, 2008, [http://www.dailytimes.com.pk/default.asp?page=2008\05\30\story\\_30-5-2008\\_pg3\\_6](http://www.dailytimes.com.pk/default.asp?page=2008\05\30\story_30-5-2008_pg3_6).
- <sup>64</sup> Tellis, no. 39
- <sup>65</sup> Mullen, "Defense Department Briefing Transcript," May 4, 2009.
- <sup>66</sup> Richard Armitage, "A Conversation with Richard Armitage," *The Charlie Rose Show*, November 6, 2007.
- <sup>67</sup> See David Sanger and William Broad, "US Secretly Aids Pakistan in Guarding Nuclear Arms," *New York Times*, November 18, 2007.
- <sup>68</sup> Khan, no. 59
- <sup>69</sup> Ansar Abbasi, "Cut in Nuke Budget: Mysterious Silence Upsets Scientists," *The News International*, Pakistan, May 10, 2009.
- <sup>70</sup> Ansar Abbasi, "SPD Also Under Pressure over Political Appointments," *The News International*, Pakistan, October 1, 2008.
- <sup>71</sup> For representative press coverage and analysis, see Zahid Hussain, "Zardari Cedes Power to Pakistani Premier," *Wall Street Journal*, November 30, 2009; Sabrina Tavernise and David E. Sanger, "Pakistan Leader Cedes Nuclear Office," *New York Times*, November 28, 2009; Mohammad Saleh Zaafer, "What Led to Change of N-Command," *The News International*, Islamabad, December 1, 2009; and B. Raman, "Why Did Zardari Keep Himself out of Nuclear Command Authority," *Intelli-Briefs*, December 3, 2009, <http://intellibriefs.blogspot.com/2009/12/why-did-zardari-keep-himself-out-of.html>. (Accessed December 28, 2009).
- <sup>72</sup> The definition of one-point safety is "when a weapon's high explosive is detonated at any single point, the probability of producing a nuclear yield exceeding four pounds TNT equivalent is less than one in a million." Ashton Carter, John D. Steinbruner, and Charles A. Zraker, *Managing Nuclear Operations*, Brookings Institution Press, Washington, D.C., 1987, p. 43.
- <sup>73</sup> Sajjad Abbas Niazi, "Seven PAF Officers among 11 Dead in Suicide Attack," *Dawn*, November 2, 2007, <http://www.dawn.com/2007/11/02/top2.htm>.
- <sup>74</sup> See Robert S. Norris and Hans M. Kristensen, "Nuclear Notebook: Pakistan's Nuclear Forces, 2007," *Bulletin of the Atomic Scientists* 63, no. 3, May-June 2007, p.72 and Nuclear Threat Initiative, "Missile Facilities: Sargodha Air Base" available at [http://www.nti.org/e\\_research/profiles/Pakistan/Missile/3294\\_3319.html](http://www.nti.org/e_research/profiles/Pakistan/Missile/3294_3319.html) (Updated December 2003). Norris and Kristensen speculate that the devices might be stored at the Sargodha Weapons Storage Complex ten kilometres south of Sargodha, rather than at the airbase itself.
- <sup>75</sup> "Nine Hurt as Bomber Hits School Bus in Kamra," *The News International*, December 11, 2007, [http://www.thenews.com.pk/top\\_story\\_detail.asp?Id=11650](http://www.thenews.com.pk/top_story_detail.asp?Id=11650).



- <sup>76</sup> See Bill Roggio, "Suicide Attack at Pakistani Nuclear Weapons Complex," *The Long War Journal*, December 10, 2007, [http://www.longwarjournal.org/archives/2007/12/suicide\\_attack\\_at\\_pa.php](http://www.longwarjournal.org/archives/2007/12/suicide_attack_at_pa.php).
- <sup>77</sup> See Norris and Kristensen, "Nuclear Notebook: Pakistan's Nuclear Forces, 2009," p.87.
- <sup>78</sup> Shakeel Anjum, "70 Killed as Suicide Bombers [Attack Wah]," *The News International*, Pakistan, August 22, 2008 and Amjad Iqbal and Mohammad Asghar, "Taliban 'Claim' Credit for Wah Carnage," *Dawn*, Pakistan, August 22, 2008.
- <sup>79</sup> See "Wah – Pakistan Special Weapons Facilities," *Globalsecurity.org* (updated April 28, 2005), [www.globalsecurity.org/wmd/world/pakistan/wah.htm](http://www.globalsecurity.org/wmd/world/pakistan/wah.htm). Gregory, "The Terrorist Threat to Pakistan's Nuclear Weapons," *CTC Sentinel*, 3, also states this claim. It is difficult to assess the veracity of these claims. The Global Security entry refers to Yossef Bodansky, "Pakistan's Nuclear Brinkmanship," Freeman Center for Strategic Studies (Houston, Tex.), January 1998 as its source about Wah. Bodansky does not list his sources. David Albright also says some of Pakistan's nuclear weapons manufacturing sites are "located near Wah." Albright, "Securing Pakistan's Nuclear Weapons Complex."
- <sup>80</sup> Even the contemporary BBC account, which Gregory cites, only refers to Wah's conventional role.
- <sup>81</sup> Salman Masood, "Attack on Pakistani Garrison City Raises Anxiety about Safety of Nuclear Labs and Staff" *New York Times*, July 4, 2009.
- <sup>82</sup> Conversations with a US Government official and a retired Pakistani military officer, October 2009.
- <sup>83</sup> Kazi, "Pakistan's HEU-Based Nuclear Weapons Programme and Nuclear Terrorism."
- <sup>84</sup> See David Albright, Paul Brannan, and Robert Kelley, "Pakistan Expanding Dera Ghazi Khan Nuclear Site: Time for US to Call for Limits," *ISIS Imagery Brief*, May 19, 2009, p.3, [www.isis-online.org/publications/southasiapakistanexpandingcpc.pdf](http://www.isis-online.org/publications/southasiapakistanexpandingcpc.pdf).
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- <sup>86</sup> Amir Mir, "DG Khan Uranium Mine Was Closed 10 Years Ago: Officials," *The News International*, May 21, 2009; also B. Raman, "Baloch Freedom Fighters Attack Nuclear Establishment," *South Asia Analysis Group*, paper no. 1801, May 17, 2006, [www.southasiaanalysis.org/papers/papers19/paper1801.html](http://www.southasiaanalysis.org/papers/papers19/paper1801.html).
- <sup>87</sup> Mir, no. 86. A somewhat half-hearted denial can be found in Ivan Watson, "Pakistan Denies Increasing Capability to Make Nukes," *CNN.com*, May 20, 2009.
- <sup>88</sup> *Ibid.*, Zofeen Ebrahim, "Pakistan: Villagers Pay the Price of Nuclear Ambitions," *Inter Press Service*, May 31, 2006.
- <sup>89</sup> Gregory, "The Terrorist Threat to Pakistan's Nuclear Weapons," *CTC Sentinel*, 2.
- <sup>90</sup> Iftikhar A. Khan and Mohammad Asghar, "Four Terrorists Killed, Ringleader Held: Skilled Commandos Rescue Hostages," *Dawn*, October 12, 2009; Mohammad Asghar and Iftikhar A. Khan, "Brigadier, Lt-Colonel Among Army Men Killed," *Dawn*, October 11, 2009; and Shakeel Anjum, "19-Hour Siege of GHQ Block Ends," *The News International*, October 12, 2009.
- <sup>91</sup> Most Indian analysts and some US analysts believe that A. Q. Khan was acting with sanction from the Pakistani state. To the extent his nuclear smuggling operation was approved by Pakistani leadership, it does not represent a security breach. For a further discussion of reasons to suspect A. Q. Khan was largely acting without state sanction, see Christopher O. Clary, *The A. Q. Khan Network: Causes and Implications*, master's thesis, Naval Postgraduate School, Monterey, California, December 2005, particularly pp. 89-90.
- <sup>92</sup> Pervez Hoodbhoy, "Whiter Pakistan? A Five-Year Forecast," *Bulletin of the Atomic Scientists*, June 3, 2009, [www.thebulletin.org/web-edition/features/whiter-pakistan-five-year-forecast](http://www.thebulletin.org/web-edition/features/whiter-pakistan-five-year-forecast). Also Hoodbhoy, "A State of Denial: Pakistan's Nuclear Threat," *International Herald Tribune*, January 17, 2008.

- <sup>93</sup> Diego Gambetta and Steffen Hertog, "Engineers of Jihad," *Sociology Working Papers*, no. 2007-10, Department of Sociology, University of Oxford, Oxford, U.K. 2007.
- <sup>94</sup> Gregory makes this point obliquely in "The Terrorist Threat to Pakistan's Nuclear Weapons," 2. For a sense of the historic geographic distribution of extremists in Pakistan, see C. Christine Fair, "The Educated Militants of Pakistan: Implications for Pakistan's Domestic Security," *Contemporary South Asia* 16, no. 1, March 2007, pp. 93-106.
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- <sup>99</sup> *Ibid.*, p. 291.
- <sup>100</sup> *Ibid.*, pp. 303, 321.
- <sup>101</sup> *Ibid.*, pp. 327-9. For an early theoretical discussion of these types of problems, see Lewis Dunn, "Military Politics, Nuclear Proliferation, and the 'Nuclear Coup D'etat,'" *Journal of Strategic Studies* 1, no. 1, May 1978, pp. 31-50.
- <sup>102</sup> See Kishore Kuchibhotla and Matthew McKinzie, "Nuclear Terrorism and Nuclear Accidents in South Asia," in Michael Krepon and Ziad Haider, eds., *Reducing Nuclear Dangers in South Asia*, report no. 50, Stimson Center, Washington DC, February 2004, p. 29.
- <sup>103</sup> *Ibid.*, p.30.
- <sup>104</sup> Abdul Mannan, *Preventing Nuclear Terrorism in Pakistan: Sabotage of a Spent Fuel Cask or a Commercial Irradiation Source in Transport*, The Henry L. Stimson Center, Washington D.C., April 2007, pp. 10-11.
- <sup>105</sup> As Khan notes, while India has expressed some interest in a rail-mobile missile, the Pakistani "railway line pattern is generally North-South pattern and perilously close and almost parallel to the border with India." Feroz Hassan Khan, "Challenges to Nuclear Stability in South Asia," *The Nonproliferation Review* 10, no. 1, Spring 2003, p. 70.
- <sup>106</sup> "Nuclear safety, nuclear stability and nuclear strategy in Pakistan," Landau Network, Centro Volta, Como, Italy, January 2002, <http://lxmi.mi.infn.it/~landnet/Doc/pakistan.pdf>.
- <sup>107</sup> Pakistan's Permanent Representative to the United Nations used very similar categories of unacceptable behaviour in a discussion in 2002 in which he pointedly noted that Pakistan had not renounced "first use" of nuclear weapons. Amb. Munir Akram, "Press Conference by New Permanent Representative of Pakistan," *UN Press Briefing*, <http://www.un.org/News/briefings/docs/2002/pakistanpc.doc.htm>.
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- <sup>109</sup> Clayton P. Bowen and Daniel Wolvén talk about "broken connectivity." "Command

and Control Challenges in South Asia,” *The Nonproliferation Review* 6, no. 3, Spring–Summer 1999, p. 28.

- <sup>110</sup> Khan, “Challenges to Nuclear Stability in South Asia,” no. 105, p. 68.
- <sup>111</sup> Sanger, no. 2.
- <sup>112</sup> Jordan Seng, “Less is More: Command and Control Advantages of Minor Nuclear States,” *Security Studies* 6, no. 4, Summer 1997, p. 83.
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