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Weapons in Response to Large Scale
Indian Conventional Attack**

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The limited military utility of Pakistan's battle-field use of nuclear weapons in response to large-scale Indian conventional attack

A.H. Nayyar¹ and Zia Mian²

General Deepak Kapoor, India's army chief, claimed in December 2009 that the army had made progress in operationalising a strategy for rapid mobilization of conventional military forces capable of mounting a decisive attack on Pakistan.³ The strategy, dubbed 'Cold Start,' can be traced to the unexpectedly slow pace of mobilization and deployment of Indian forces to the border with Pakistan after the December 2001 attacks on India's parliament by militants believed to be linked to Pakistan.⁴ It involves the creation of eight to ten 'integrated battle groups' (IBGs) of army, air force and special forces intended "to destroy and not to hold or capture territory."⁵

As part of this doctrine, India's armed forces have been rehearsing large scale manoeuvres, the most significant of which came in a May 2006 military exercise close to the border with Pakistan.⁶ The *Sanghe Shakti* (Joint Power) exercise brought together strike aircraft, tanks, and over 40,000 soldiers from the 2nd Strike Corps in a war game whose purpose was described by an Indian commander as "to test our 2004 war doctrine to dismember a not-so-friendly nation effectively and at the shortest possible time."⁷ General Daulat Shekhawat, Commander of the Corps, explained that "We firmly believe that there is room for a swift strike even in case of a nuclear attack, and it is to validate this doctrine that we conducted this operation."⁸

General Parvez Kayani, Pakistan's Chief of Army Staff, responded to General Kapoor's 2009 assessment by declaring that "Proponents of conventional application of military forces, in a nuclear overhang, are chartering an adventurous and dangerous path, the consequences of which could be both unintended and uncontrollable."⁹ The implication seemed to be that Pakistan might use nuclear weapons in response to an Indian conventional assault. A former Pakistani brigadier has argued that Pakistan could forestall Cold Start since "the Pakistani Army can occupy their wartime locations earlier than the Indian army" and in any case "failure to do so could lead to firing of low-yield tactical warheads at IBGs as they cross the start line or even earlier."¹⁰ This implies Pakistan's use of nuclear weapons against Indian conventional forces either before or soon after these forces cross the international border

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The views of the authors are entirely their own and should not be construed as reflecting the views of the PSRU, or the University of Bradford.

³ Rajat Pandit, "Army Reworks War Doctrine for Pakistan, China," *The Times of India*, 30 December 2009.

⁴ For details of the origins of Cold Start and constraints on its operationalisation see Walter C. Ladwig III, "A Cold Start for Hot Wars?: The Indian Army's New Limited War Doctrine," *International Security*, Vol. 32, No. 3 (Winter 2007/08), pp. 158–190.

⁵ "Army Conducts Largest Ever War Games in Recent Times," *Times of India*, 19 May 2006.

⁶ *Ibid.*

⁷ "Indian Military Rehearse Pakistan's Dissection in Mock Battles," *Defense News*, 3 May 2006.

⁸ "Indian Army Tests its New Cold Start Doctrine," *Indo-Asian News Service*, 19 May 2006.

⁹ Iftikhar Khan, "Tough Kayani Warning to Proponents of 'Adventurism'," *Dawn*, 9 February 2010.

¹⁰ Javed Hussain, "A Challenging Doctrine," *Dawn*, 8 February 2010.

While Pakistani leaders have issued no formal nuclear doctrine, it is widely understood that they are prepared to initiate the use of nuclear weapons in a conflict.¹¹ Pakistan has consistently rejected suggestions that it adopt a policy of no-first use of nuclear weapons, and has instead reinforced the notion that its nuclear weapons are meant in part to counter India's larger conventional military forces.¹²

India seems to have anticipated the possibility of Pakistani leaders using nuclear weapons against Indian military forces. Since the early 1980s, confronted with the prospect of possible Pakistani use of nuclear weapons on the battle-field, Indian forces have prepared to survive and prevail. Indian Army Chief General K. Sundarji claimed in early 1987 "We in the armed forces are gearing our organization, training and equipment in such a manner that in the unlikely event of the use of nuclear weapons by the adversary in the combat zone, we will limit the damage, both psychological and physical."¹³ The year-long *Brasstacks* exercise in 1986 involved Indian tanks and other armoured vehicles practising procedures for moving through an area that had been subject to nuclear attack.¹⁴

The May 2001 Indian military exercises *Poorna Vijay* (Complete Victory) gave every indication that Indian planners anticipate Pakistan's battle-field use of nuclear weapons.¹⁵ The exercises were aimed at testing equipment, troops and maneuvers in a situation where nuclear weapons were used against them, with an Indian official confirming that "Drills and procedures to meet the challenges of a nuclear, chemical or biological strike are also being practiced."¹⁶ Among the options worked through were a Pakistani nuclear attack on a bridgehead or bridge, armored forces and troops.¹⁷ A year later, India's Deputy Chief of Army Staff, Lt.-General Raj Kadyan, confirmed that the Indian army was continuing to train to cope with a nuclear strike on the battle-field.¹⁸

We look below at the conditions under which Pakistan might use its nuclear weapons in response to an Indian conventional military attack, looking in particular at the implications of the battle-field use of nuclear weapons to stem a large-scale incursion by Indian armoured forces. We assess the military consequences of such use given the possible number and yield of nuclear weapons Pakistan might have available. We do not include here the effects of the large-scale use of nuclear weapons on civilian populations or on the ecosystems on or close to the battle-field.

If Pakistan Goes Nuclear

There have been some suggestions of where Pakistan may first use its nuclear weapons. They imagine large Indian armored formations and ground forces threatening to take further territory or inflict further defeat on Pakistani conventional forces. A nuclear strike by Pakistan on Indian forces in Pakistani territory, when there is no conventional response left to Pakistan, might be aimed at preventing imminent conventional defeat rather than fighting and winning a

¹¹ Pervez Hoodbhoy and Zia Mian, *The India-Pakistan Conflict - Towards the Failure of Nuclear Deterrence*, 2002. www.zmag.org/content/showarticle.cfm?ItemID=2659.

¹² Masood Haider, "Islamabad Refuses to Accept 'No First Strike' Doctrine," *Dawn*, 31 May 2002.

¹³ W.P. S. Sidhu, "India's Nuclear Use Doctrine," in Peter Lavoy, Scott Sagan and James Witz, eds., *Planning The Unthinkable: How New Powers Will Use Nuclear, Biological and Chemical Weapons*, Cornell University Press, Ithaca, 2000, p.128.

¹⁴ Manoj Joshi, "Atomic Age Warfare," *India Today*, 20 July 1998.

¹⁵ "Bracing for a Nuclear Attack, India Plans 'Operation Desert Storm' in May," *The Indian Express*, 1 May 2001

¹⁶ "Unmanned Aerial Spies Used in Wargames," *The Times of India*, 8 May 2001.

¹⁷ Harinder Bajewa, "Readying For Nukes," *India Today*, 28 May 2001.

¹⁸ "Army Ready to Face N-strike," *Hindustan Times*, 26 June 2002.

nuclear war. The goal might be to use nuclear weapons to support conventional forces and as the U.S. army manual suggests to “dramatically increase the possibilities for sudden alterations on the battlefield, which attacks can exploit.”¹⁹

One analysis argues that Pakistan would initiate the use of nuclear weapons on Pakistan’s own soil against Indian attacking forces, and then use them against military targets in India near Pakistan border and finally attack cities.²⁰ Another historian of Pakistan’s army and its wars suggests that “If India’s two armor-heavy mechanized infantry strike corps managed to penetrate to the line joining Gujranwala-Multan-Sukkur and to the outskirts of Hyderabad in the South, then it is likely Pakistan would have to accept defeat or employ nuclear weapons.”²¹ These cities are roughly 50 km, 190 km, 90 km and 130 km respectively from the nearest points on the border with India. (See Figure 1 for a map.)

In the late 1990s, US military war-gaming of a possible conflict between India and Pakistan involved a situation, where after several days of conflict, “Pakistani forces in the north were defeated and Indian forces moved quickly across the Thar desert toward the Indus River” and Pakistan responds with “four nuclear weapons.”²² The war-game imagined Pakistan using three 20 kiloton nuclear weapons aimed at “halting invading Indian forces on the border” and the fourth against a rail hub. In the game, India retaliates by launching twelve nuclear weapons at Pakistan’s nuclear and command facilities, including near the capital Islamabad.



Figure 1: Map of Pakistan showing the capital (Islamabad), and the cities of Gujranwala, Multan, Sukkur, Hyderabad, and Lahore. It has been suggested that if Indian military forces were to reach the line joining Gujranwala, Multan, Sukkur and Hyderabad, then Pakistan may either have to accept defeat or use nuclear weapons. (Courtesy: Google Earth.)

¹⁹ “Operations,” *US Army Field Manual FM-100-5*, Department of Army, Washington, D.C., 1982, p.8–6

²⁰ Stephen P. Cohen, *The Pakistan Army*, Oxford University Press, New York, 1998 edition, p.178.

²¹ Brian Cloughley, *A History of the Pakistan Army: Wars and Insurrections*, Oxford University Press, Karachi, 1999, p.340–41.

²² Bradd C. Hayes, “International Game ’99: Crisis in South Asia”, Research Report 99-1, Decision Support Department, Center for Naval Warfare Studies, United States Naval War College, 1999, p.8.

There is some uncertainty about the yield and number of nuclear weapons Pakistan may have available, should it decide to use them. Pakistan's nuclear weapon tests of 28 May 1998 involved as many as five devices and the yield of individual devices is uncertain. Samar Mubarikmand, the scientist who led the nuclear weapon tests, claimed the subsequent nuclear test of 30 May 1998 involved "only one device and its yield was 15 to 18 kT [kilotons]." ²³ An independent estimate by the Federation of American Scientists and the Natural Resources Defense Council, the leading nongovernmental researchers tracking nuclear arsenals, suggests Pakistan may have between 70-90 nuclear weapons, as of 2010. ²⁴

We consider in the next section what might be the actual effect of Pakistan's use of such nuclear weapons against Indian land forces. As noted earlier, we do not include the effects of the use of potentially very large numbers of nuclear weapons on the civilian population or ecosystems in the war zone.

Battle-field Use of Nuclear Weapons

Indian military exercises have simulated attacks on Pakistan involving over 1000 tanks and armoured vehicles. The 1986 exercise *Brasstacks* involved 1300 tanks. ²⁵ The 2001 *Poorna Vijay* military exercise involved 1000 tanks and armored vehicles. ²⁶ Details of the deployment within the exercise are not available. The Indian army order of battle has been suggested as comprising regiments of 55 tanks, with six tank regiments in an armoured division. ²⁷ This suggests that several divisions were involved in the exercises simulating war with Pakistan.

The United States planned for large tank battles in the early stages of a war with the Soviet Union in Central Europe. It was expected that a heavy division would defend a standard front 25 km wide. ²⁸ These deployments became much closer when units were attacking, with the operational front for an armoured division being roughly 8–10 km. ²⁹ For the United States an armoured formation for "deliberate attack or breakthrough" used vehicles spaced 50 meters apart in each row, and the rows were set 200–250 meter apart. ³⁰ This is equivalent to 80 armoured vehicles per km².

The density of 80 armoured vehicles per km² is equivalent to that of a triangular lattice with points spaced about 120 meters apart. Soviet armoured vehicles were typically spaced 100 meters apart. ³¹ If they were in a triangular formation, they would have an effective density of 115 vehicles per km². Increasing the spacing to 200 meters reduces the density of vehicles to

²³ Khalid Qayyum, "Shaheen Missile Awaits Go-ahead for Test Fire," *The Nation*, 1 June 1998.

²⁴ Robert S. Norris and Hans M. Kristensen, "Global Nuclear Weapons Inventories, 1945–2010," *Bulletin of Atomic Scientists*, July/August 2010, pp.77–83.

²⁵ Kanti Bajpai, P.R. Chari, P.I. Cheema. S. P. Cohen. S. Ganguly, *Brasstacks and Beyond: Perception and Management of Crisis in South Asia*, Manohar, Delhi, 1995, p.30.

²⁶ "Experts Feel War, if Fought, Will be Across the Desert," *The Statesman*, 16 February, 2000.

²⁷ *Indian Army ORBAT*, <http://www.bharat-rakshak.com/LAND-FORCES/Army/Orbat.html>.

²⁸ William P. Mako, "Demands on Ground Forces in Central Europe in the 1980s," in *The Force Planning Faculty, Naval War College, eds., Foundations of Force Planning: Concepts and Issues*, Naval War College Press, Newport, 1986, p.401.

²⁹ James F. Duncan, *How to Make War: A Comprehensive Guide to Modern Warfare*, William Morrow, New York, 1988, p.414.

³⁰ "The Tank and Mechanized Infantry Battalion Taskforce," *Field Manual No. 71-2*, U.S. Department of the Army, Washington D.C., 1977, p.5-10.

³¹ S.T. Cohen and W.R. Van Cleave, "Western European Collateral Damage from Tactical Nuclear Weapons," *RUSI Journal*, June 1976, p.36

below 30 per km². A density of 3 vehicles per km² is achieved by spacing them about 540 meters apart. This kind of density has been reported for US and Soviet divisions in Europe.³²

Nuclear weapons produce three important immediate destructive effects: blast, heat and prompt radiation in the form of gamma rays and neutrons. All three effects are expressed equally in all direction and decrease with distance. To estimate how many tanks and crews may be affected by each of these, it is worth noting that for separation of d meters between neighbouring tanks, the number of tanks in a circle of radius r meters is $3.6(r/d)^2$.

Blast

In actual nuclear weapon tests involving military equipment, a 10 kT explosion at a range of 370 meters produced a peak static overpressure of 33.35 psi (note: 1 atm = 14.7 psi) and a tank oriented on its side towards the explosion was displaced about 2.5 meters with acceleration sufficient to inflict moderate damage to external fittings such as track guards, but the tank was able to be driven off and its gun fired after sand and debris had been removed from the barrel.³³ It seems reasonable to assume that an overpressure of 3 atm (about 45 psi) is sufficient to damage a tank so that it cannot continue to function on a battle-field.

A standard description of the effects of nuclear weapons notes that a 1 kT explosion at a height of about 150 meters produces overpressures of 45 psi at horizontal distances from ground zero as large as about 170 meters. The distance l ratios scale as the 1/3 power of the ratio of yields.³⁴ This means that a 15 kT burst at a height of about 400 m would generate an overpressure of 3 atm up to a distance of about 420 meters, i.e., over an area of 0.55 km². The number of tanks, N , in this circular area varies as the inverse square of the inter-tank distance d and is approximately given by $(800/d)^2$.

For a tank spacing of 100 meters, one 15 kT weapon could destroy about 55 tanks. To destroy this many tanks if they were spaced 300 meters apart would take 8 weapons of 15 kiloton yield each. To destroy by blast alone roughly half of a force of 1000 tanks that were well dispersed would require on the order of 100 nuclear weapons of 15 kiloton yield.

Heat

A second large effect of nuclear weapons is the intense heat that they generate. The heat flux is instantaneous; lasting only a second. This leads to large firestorms in cities but the effects of this heat on the battle-field, especially on vehicles and their crews, is not as severe.

The Effects of Nuclear Weapons gives standard curves for thermal radiation from a nuclear explosion.³⁵ Extrapolating this to a 15 kT explosion at a height of 400 meters suggests that at a ground distance of 500 meters from ground zero the thermal flux from such an explosion is about 150 calories per square centimeter. Exposure to a thermal dose of 15 cal/cm² is fatal to a person. Anyone in the open on the battle-field up to a distance of 1.3 km would be killed. Those at distances out to 2 km would suffer burns.

The damage to tanks and other armoured vehicles and their crews is more difficult to determine. We assume, as a worst case scenario, that there are no radiative losses, and all the

³² Duncan, *How to Make War*, p.415.

³³ Charles S. Grace, *Nuclear Weapons: Principles, Effects and Survivability*, Brassey's, London, 1994, p.58.

³⁴ Samuel Glasstone and Philip J. Dolan, *The Effects of Nuclear Weapons*, Third Edition, US Government Printing Office, Washington D.C., 1977.

³⁵ Glasstone and Dolan, *The Effects of Nuclear Weapons*, p.371, Fig. 8.123a.

heat received is absorbed by the tank's surface. Because the tank body is made of steel which is a good thermal conductor, all the heat energy received would be rapidly distributed over the entire volume of the tank's steel body. Since at most half the surface area would be exposed to the thermal flux, a tank's body temperature would rise by about 2–3 C.³⁶

Thus thermal radiation, while fatal for foot soldiers to a distance of about 1 km from ground zero, will not add significantly to the damage caused by blast on tanks and armoured vehicles.

Radiation Effects

In addition to blast and heat, nuclear weapons produce prompt radiation as both neutrons and gamma rays, the latter including direct fission product gammas and secondary gammas from the interaction of the released neutrons with the air. These can be highly destructive of military operations by disabling and killing soldiers, including the crews of armoured vehicles.

The US army assumes that radiation doses of 3000–8000 rads or more would be required to destroy front-line enemy troops.³⁷ The *US Army Field Manual* reports that radiation doses on this scale cause severe and prolonged vomiting, diarrhea, fever and prostration within 5 minutes leading to complete incapacitation, with partial recovery after 45 minutes, and death within 5 days.³⁸ Higher doses lead to complete and permanent incapacitation and death within 15–48 hours. Doses down to 800 rads can cause severe and prolonged vomiting, diarrhea, fever within half an hour to an hour and reduced combat effectiveness, with death within 14 days. Following U.S. practice, we assume a critical dose of 3000 rads as sufficient to incapacitate military personnel inside tanks.

The Effects of Nuclear Weapons gives standard curves for prompt radiation from a nuclear explosion as a function of distance.³⁹ Only a fraction of the radiation incident on a tank will be transmitted to the crew inside, however. The transmission factors for a tank are 20% of incident prompt gamma rays and 30% for neutrons. The transmission factors are at least 2 to 3 times this for the much thinner skinned armoured vehicles used to carry infantry.⁴⁰

For a 15 kiloton yield explosion at a height of about 400 meters, and including the effect of transmission factors, the collective neutron and gamma dose is 1500 rads at a slant distance of 1100 meters and nearly 5000 rads at a slant distance of 900 meters. For simplicity, it is assumed that the collective neutron and gamma dose equal to the critical dose of 3000 rads is produced at a slant distance of 1000 meters, which, for an explosion at a height of 400 m would amount to a ground distance of 920 meters from the explosion.

If the attack is organised around tank divisions of 330 tanks, with each division moving forward on a 10 kilometer long front, then the 1000 tanks would occupy a 30 km long front. The depth of the formation would be determined by the spacing of the tanks. As noted earlier, an attacking tank formation following U.S. tactics might have tanks that are 50 meters apart in rows separated by 250 meters (the effective spacing would be 120 meters). A force of tanks prepared for a possible nuclear strike might have larger distances between individual tanks.

³⁶ This assumes that the tank body is made of 5 cm thick steel. For steel density of 7850 kg-m⁻³ and specific heat capacity of 108 cal-kg⁻¹-K⁻¹, each 5 cm³ volume (a hypothetical cylinder in the tank body with a base area of 1 cm²) would experience a rise in temperature of only 4.6 C.

³⁷ "Tactical Nuclear Operations," *US Army Field Manual FM-100-5*, Washington DC, 1982, p.10–3.

³⁸ "Operations," *US Army Field Manual FM-100-5*, p.4–3.

³⁹ Glasstone and Dolan, *The Effects of Nuclear Weapons*, p.371, Fig. 8.123a.

⁴⁰ Grace, *Nuclear Weapons: Principles, Effects and Survivability*, Table 6.4.

The prompt radiation from a 15 kT weapon would kill or incapacitate crews in 75 tanks if the tanks were deployed with an effective spacing of 120 m, but only affect the crews of 35 tanks if they were 300 meters apart. For tanks separated by even greater distances, it would require the use of over 80 nuclear weapons of 15 kT yield each to disable or kill the crews in a force of 1000 tanks.

Conclusion

The analysis presented here suggests that while Pakistan has sufficient nuclear weapons to destroy a significant proportion of any invading Indian armoured force, it may exhaust most of its arsenal of an estimated 70–90 weapons in such an attempt. If Indian armed forces had prepared for a nuclear attack and were able to rapidly disperse, Pakistan may not have sufficient nuclear weapons to be able to destroy an Indian force. It is possible that the Pakistan army has recognized this problem. It has purchased 5250 TOW wire-guided heavy anti-tank missiles from the United States, of which about 2000 have been delivered as of early 2009.⁴¹

This conclusion about the limited utility of small numbers of nuclear weapons on a possible South Asian battle-field echoes the experience of the United States and Soviet Union in the European theatre. In their search for ways to counter the large armoured land forces of their adversary, the United States and Soviet Union built up arsenals of tens of thousands of battle-field and tactical weapons. The US for instance had as many as 20,000 tactical nuclear weapons in its arsenal in 1967.⁴²

It is possible to imagine that Pakistan may choose to respond to an Indian conventional attack by using one or a few nuclear weapons as a signal to India to terminate the attack or risk a larger escalation possibly including use of nuclear weapons against Indian cities. Indian policy makers have sought to deter such possible Pakistani use of nuclear weapons on the battle-field. In 2003, India's cabinet announced that as part of India's nuclear doctrine, "nuclear weapons will only be used in retaliation against a nuclear attack on Indian territory or on Indian forces anywhere."⁴³ The explicit mention of "Indian forces anywhere" suggests that Pakistan's battle-field use of nuclear weapons against Indian conventional forces could trigger an Indian nuclear response, possibly also on the battle-field.

The same logic prevailed between the United States and Soviet Union during the Cold War, which led to the deployment of large numbers of battle-field nuclear weapons by both sides. These large numbers suggest that the United States and Soviet Union had decided that the threat of battle-field use and retaliation was likely to be taken to be more credible than the threat to escalate directly from a conventional conflict to an attack on a major target in the other state. Nonetheless, each side anticipated that a war would escalate to all out nuclear war and the destruction of cities. This will likely be the case in South Asia, and adds to the futility of preparing for the battle-field use of nuclear weapons.

Faced with the limited utility of using nuclear weapons in response to large conventional forces on the battlefield and in the larger European theatre, the United States and Soviet Union eventually agreed a series of treaties. The 1987 Intermediate Nuclear forces Treaty

⁴¹ K. Alan Kronstadt, *Pakistan-U.S. Relations*, Congressional Research Service, Washington D.C., 6 February 2009, p.58. For details of TOW missiles, see for example, www.army-technology.com/projects/tow.

⁴² Nicholas Zarimpas, "Tactical Nuclear Weapons," in *SIPRI Year Book 2002: Armaments, Disarmament and International Security*, Oxford University Press, New York, 2002, pp.568–569.

⁴³ *The Cabinet Committee on Security Reviews Operationalization of India's Nuclear Doctrine*, Ministry of External Affairs, New Delhi, 4 January 2003. <http://meadev.nic.in/news/official/20030104/official.htm>.

banned ground-launched ballistic and cruise missiles with ranges of between 500 and 5,500 kilometers, and required that their launchers and associated support structures and equipment be destroyed.⁴⁴ The 1990 Conventional Forces in Europe Treaty aimed to create a “secure and stable balance of conventional armed forces in Europe at lower levels than heretofore, of eliminating disparities prejudicial to stability and security and of eliminating, as a matter of high priority, the capability for launching surprise attack and for initiating large-scale offensive action in Europe.”⁴⁵ It required large reductions in military equipment and obliged an annual exchange of military information and established a system of inspections. In 1991, through unilateral but coordinated presidential initiatives the United States and Soviet Union removed from active service their ground-launched short-range nuclear weapons, tactical nuclear weapons on ships and submarines, and land-based naval aircraft.⁴⁶ Pakistan and India might usefully consider such steps in the South Asian context.

⁴⁴ *Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles (1987)*.

www.state.gov/www/global/arms/treaties/inf1.html

⁴⁵ *Treaty on Conventional Armed Forces in Europe (1990)*. www.state.gov/www/global/arms/treaties/cfe.html.

⁴⁶ “The Presidential Nuclear Initiatives (PNIs) on Tactical Nuclear Weapons at a Glance,” Arms Control Association, Washington D.C., undated. www.armscontrol.org/factsheets/pniglance.