14th Major General Samir Sinha Memorial Lecture, 2016

Development of Tactical Nuclear Weapons by Pakistan and Implications for India*

Lieutenant General Arun Kumar Sahni, PVSM, UYSM, SM, VSM (Retd)@

Introduction

The subject of the talk for the 13th Samir Sinha Memorial lecture is timely, contextual and extremely relevant. It is a coincidence that it follows the recently concluded fourth "Nuclear Security Summit of Heads of States'', held at Washington on 29 Mar and 01 April 2016. Of relevance to us is a statement by the US President during the summit, indicating the underlying belief in the US that Pakistan is endeavouring to acquire Tactical Nuclear Weapons (TNWs).

In consonance with the mandate given to me by this esteemed Institution, it shall be my endeavour to address three primary issues. Initially, examine the veracity of the statement that "Tactical Nuclear Weapons in South Asia Lowers the Nuclear Threshold'' followed by seeing "Its impact on the Deterrence dynamics in South Asia" and "Is there a need to revisit India's nuclear doctrine?" Also, ascertain if Pakistan has the capability and technological expertise to manufacture weaponised short range ballistic missile (SRBM) (Nasr). Premising that Pakistan does have or decides to pursue this path of fielding battlefield nuclear systems, one shall see the challenges that go with it for their command and control, survivability cum protection, delegation of authority for use in the tactical battlefield and related psychological pressure on commanders to utilise these nuclear assets earliest.

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@**Lieutenant General Arun Kumar Sahni, PVSM, UYSM, SM, VSM (Retd)** was commissioned into the Regiment of Artillery on 13 Jun 1976 and retired as General Officer Commanding-in-Chief, South Western Command on 31 Jan 2016. He was a recipient of the prestigious 'Sword of Honour' and the President's Gold Medal on commissioning from the Indian Military Academy, Dehradun. During his service career, he has been intimately involved with strategic issues and is known for his understanding of national security matrix and the emerging international dynamics.

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As a statement of fact, I think it is indisputable that there will be a lowering of the nuclear threshold on induction of TNWs in the Indian subcontinent. But is it a possibility/reality, are the issues that will be examined. Or is it a bogey created by the western strategist's reading more into the recent test firing of 'Nasr'? Or is it a conspiracy / design of China to use Pakistan as a proxy to create pressure on India? Or is it a method adopted by Pakistan to ascribe greater ambiguity to its nuclear strategy? Or finally, is it a combination of some or all these issues?

There is no ambiguity in the subcontinent that nuclear weapons between India and Pakistan are political instruments. It is also accepted by both nations that 'Strategic Nuclear Weapons' are only 'instruments for deterrence' and not for nuclear war fighting. Hence, Pakistan's *volte-face* to develop TNWs/non-strategic weapons, acknowledged to be instruments for nuclear war fighting, raises several questions, namely :-

(a) What prompted Pakistan to develop the SRBMs?

(b) Is there any similarity of conditions for the induction of TNWs in South Asia, to what existed during the Cold War in Europe, being alluded to as the rationale by Pakistan?

(c) How would the SRBMs affect deterrence and strategic stability in South Asia?

Nasr

Let us see this monster that has started the debate on TNWs in the subcontinent. There is irrefutable evidence of this missile system being based on Chinese design cum technology. As per assessment, the system is a four tube adaptation of a Chinese multiple launch rocket system (MLRS), possibly the A-100 type, mounted on an eight-wheeler truck, capable of carrying four 'ready-to-fire', 20 ft ballistic missiles of about 300 mm (11.8 inch) diameter. The truck launcher itself may be a Chinese copy of the Russian 300 mm Smerch (MLRS) missile system. The weapon yield is stated to be 0.5 to 5 kiloton, with a Plutonium warhead. The shoot and scoot attributes of the Nasr means that the launchers can quickly fire and change location to avoid counter-targeting.

Pakistan officially maintained after the testing of the SRBM, Nasr, that it was a strategic asset which was supported by various

indicators. Firstly, the Inter-Services Public Relation's prompt but ambiguous press release after the test firing stated that this SRBM is an addition to its 'Deterrence Capability'. Another indicator to reinforce that it is an instrument of deterrence was the presence of only the senior members of the "strategic forces at the flight test. Subsequent statements of senior officials at different forums also implied that Nasr would most likely be an asset of Pakistan Army's Strategic Force Command (ASFC)."

But the official statements in 2015 by Pakistan's Foreign Secretary, Mr Aizaz Chaudhry, in Oct 2015, preceding the US visit of Pakistan's Prime Minister and remarks made by Mr Kidwai, ex-Director General Special Plans Department (DG SPD) and adviser to Pakistan National Command Authority (NCA), at a press conference at the Carnegie International Peace Conference in 2015, clarified unequivocally Pakistan's intention with respect to the growth vector of nuclear weapons. The latter stated that the development of TNWs was to deter India from using its 'conventional superiority' and to nullify India's Cold Start Strategy.

Defining TNWs

The definition of TNWs is important and not a question of mere semantics, because the associated nuances of what is a tactical weapon, will assist in examining the response or future course of action that needs to be taken by India. The USA and erstwhile USSR agreed on range based definition for strategic nuclear delivery vehicles in the First (1972) and Second (1979) Strategic Arms Limitation Accords and in the START 1 Treaty of 1991. However, in the case of tactical or battlefield nuclear weapons they were either not willing or were unable to come to a common definition. In hindsight, it was due to their diverse employment doctrines.

This stands corroborated by the accepted definitions given in the 'NATO and Russian Glossary of Nuclear terms and definitions'.[1] In case of the Russians they are classified as non-strategic for engagement ranges less than 5000 kms, operational for engagement upto 500 kms and tactical for ranges upto 300 kms. Whereas, for the US it is non-strategic for employment in a theatre of operations and Theatre Nuclear Forces for localised military missions.

Thus, as per western perspective, the difference between strategic and TNWs was either a function of range, yield, or the methodology of employment. The TNWs can, therefore, be defined as short-range (from as less as 2-4 kms to a maximum up to 500 kms) and low-yield weapons (0.4-40 kilotons to a maximum of 150 kilotons), meant for counter-force targeting in the battlefield. These could be surface (ballistic and cruise) and air-launched weapons.

In context of the realities of the Cold War era, the differentiation was also rooted in capability of nuclear weapon systems to attack American or Soviet/Russian mainland and the extended deterrence commitment of the USA towards its NATO allies. *Range, and not the yield, was thus the primary factor in deciding what constitutes a tactical or strategic nuclear weapon* (emphasis added).

However, in the subcontinent, Pakistan and India have contiguous borders unlike the East-West proxy battlegrounds of Europe. Also, devastation caused by employment of TNWs in case of South Asia will be on its own territories due to proximity of densely populated areas next to the borders and not on a spatially segregated battlefield, as in Europe. Thus the impact will have strategic effect in terms of damage, number of casualties, radiation fallout, as well as the administrative and logistical challenges. Therefore, it would be fair to consider all nuclear weapons in South Asia to be strategic.

Apropos, if one endeavours to define these short range weapons in our context, then we could classify these as "battlefield nuclear weapons''. They could be SRBMs with ranges within 50-150 kms range, with a maximum yield of 5 to 10 kilotons. The targeting and employment of TNWs by Pakistan would primarily be counter-force, in consonance with the rationale being propounded to acquire them to counter Indian army's mechanised spearheads. Therefore, in the subcontinent, employment considerations would far outweigh the criteria of range and tonnage of the warheads while developing the weapon systems.

Reasons for Pakistan to Develop TNWs

It would be fair to state that the landmark events of Operation Vijay 1999 and Operation Parakram 2001 led to doctrinal shift for both India and Pakistan. India, realising the shortcomings, enunciated its 'Cold Start Strategy', that later matured to the current

'Pro-active Strategy'. It also resulted in operational modulations to reduce mobilisation time and hone the combat edge. This strategy was also tailored to exploit the intrinsic weakness created in the defensive deployment of Pakistan, due to its commitment along the Af-Pak Border.

As a consequence of India's doctrinal shift, Pakistan carried out a series of analytical studies culminating in the Azm-e-Nau series of discussions/ exercises. This may have been the trigger for Pakistan to develop TNWs to further curtail the space for conventional conflict. The major reasons that can be attributed for the testing of Nasr could be :-

(a) India's military doctrine of Cold Start / Pro-active Strategy.

(b) Asymmetry in the combat force ratios in the conventional spectrum, which is likely to only increase.

(c) Development of Ballistic Missile Defence (BMD) capability by India and perceived impact on the existing deterrence dynamics.

(d) Increasing capability of the Indian Armed Forces to strike and interdict deep inside Pak territory in case of a conventional conflict.

Pakistan and western political/military analysts justify Pakistan's effort for acquiring TNWs to the Cold War analogy.[2] The reasons attributed at that time by the US for development and deployment of the TNWs was to counter the overwhelming superiority of the Soviet mechanised forces and their application on multiple thrust lines. This led to subsequent proliferation amongst the Cold War adversaries.

The Cold War – Parallel

TNWs were developed during the Cold War in the 1950s by the USA, NATO and the Soviet Union. It was the US that first deployed these in Europe (NATO countries) to counter the conventional military superiority of the Soviet Union. Another rationale attributed was to save money, as the US forces were downsizing during the Eisenhower era. This resulted in formulation of associated doctrines and operational planning, including integrated fire planning of atomic and conventional weapons. Also, as the Soviet Union achieved

sophistication in their strategic nuclear delivery vehicles, it became difficult for the US to strengthen nuclear deterrence only through strategic nuclear weapons.

For NATO, a combination of conventional and nuclear weapons including TNWs was crucial for its strategy of 'flexible response' and remained so through the 1970s.[3] The Soviet Union also viewed their TNWs and conventional capabilities as integrated components of their offensive doctrine.

The major area of concern for employment of nuclear weapons on the battlefield, is the Command and Control[4] during hot war. 'Command' of nuclear weapons is concerned with the conduct of military operations to achieve political objectives and 'control' is a function of technology and the processes of checks and balances for the delegation cum devolution of authority for employment of nuclear assets on the battlefield. The primary pre-requisite for 'effective control' is the prevention of accidental or inadvertent launch. However, the balance has to be maintained, for too much of control can lead to delay in employment. Also, effective command and control demands a robust, secure and foolproof communication linkage between the decision makers and the delivery system. This becomes more critical in the case of TNWs for the decision maker, due to shorter time of flight of these missiles/ munitions.

The complexity of this function of command, in case of the TNWs, can be summed up by the three intricate dilemmas which are quite self-explanatory. Firstly, the short ranges of these weapon systems require their deployment closer to the battlefield and commanders have to contend with the dilemma of 'use them or lose them'. Correspondingly, there is greater pressure on escalation. Also, there is the dilemma of 'always - never' as the system is required to do two very contradictory functions. It must always deliver when it is so required, and must never fail in peace time by permitting unauthorised use. Lastly, is the 'request – release' challenge for the commanders. This existed for the commanders during the Cold War and shall exist for Pakistan, if it goes all the way to give shape to its desire for inducting battlefield nuclear weapons in South Asia.

The challenge of 'request - release' needs elaboration as it was unique to the European battle space, due to specific political compulsions of NATO members towards development and

manufacture of TNWs. The nuclear warheads/ munitions were stored by the USA with its "Custodial Detachments" across the European battle space. These warheads were issued on approval of a formal request, vetted up the channel, to the nearest NATO fire unit that could engage the enemy. The issue (of warheads) by the custodial detachment was on receipt of authenticated nuclear command orders. The commanders made alternate conventional plans as a backup, in case the request was turned down. These alternate plans also contributed to the ambiguity involved in meshing conventional and nuclear fire planning.

Another very important facet of employment of nuclear weapons is the issue of "positive and negative control measures". Positive control concerns the authorisation of nuclear operations, which can only be given by authorised decision makers. On the other hand, negative control seeks to prevent accidental or unauthorised use of nuclear weapons including possible theft by non-state actors.[5] The "positive control" is exercised through mechanical/electronic devices referred to as "Permissive Action Link (PAL).[6] The "negative control" to obviate unauthorised use, prior to the release from NCA is maintained by the 'two man'/'three man' rule or through PALs.

The other critical issue is the security and protection of these assets from both, adversary and non-state actors. The situation is exacerbated when there is domestic instability in the country, as in Pakistan.

Deterrence Dynamics - South Asia

India's complexity with respect to nuclear deterrence is unprecedented, as it has two nuclear armed contiguous neighbours, with very different compulsions for being nuclear armed countries. Also, they have absolutely diametrically different policies. China considers its primary threat from the US and has a declared 'No First Use' (NFU) policy; whereas Pakistan's threat is India centric, with a declared 'First Use' policy. In spite of the challenges, since the Indo-Pak nuclear tests of 1998, a semblance of strategic stability exist; thus, confirming the success of "Nuclear Deterrence" in South Asia.

Presently in international relations, 'deterrence' or 'compellence' are the options available to achieve stability amongst nation states with irrevocable divergent viewpoints on contentious issues. Compellant action requires that the target state alter its behaviour in a manner quite visible to all in response to an equally visible initiative taken by the coercer state. In contrast deterrent threats are easier for the target state to ignore or to acquiesce without loss of face. Deterrence, a legacy of the Cold War seemed to be out-dated in view of the events in Afghanistan and the Middle East. But the stand-off in Ukraine, between Russia and the USA has highlighted its continued relevance. In the context of South Asia with the existing force structures and prevailing politico-economic-social compulsions, deterrence is the preferred means to achieve strategic stability.

Understanding Deterrence

Deterrence as a strategy intends to dissuade an adversary from taking an action not yet started, or to prevent them from doing something that another State desires. Deterrence can be achieved by evoking 'Fear of Punishment', or 'Denial of Objectives' or 'Risk of Conflict'. The "Deterrence Theory" gained increased prominence as a military strategy during the Cold War, with regard to the use of nuclear weapons. It took on a unique connotation during this time as an inferior nuclear force, by virtue of its extreme destructive power, could deter a more powerful adversary, provided that this force could be protected against destruction by a surprise attack.

The policy of deterrence as outlined by the military analyst PK Huth, can be categorised as "direct deterrence", where the target is the defender and requires to prevent an armed attack against its own territory and "extended deterrence". The latter is the case of the USA where it extends its nuclear umbrella to its allies. Building on these two broad categories, Huth goes on to outline that deterrence policy may be implemented in response to a pressing short-term threat, known as "immediate deterrence". Or it is "general deterrence", a long term strategy to prevent military conflict.

Apropos, the stated nuclear doctrines of India and Pakistan can be categorised as Direct Deterrence, as both the countries are directly involved and it is General Deterrence for it aims to

deter war. Thus, these doctrines resonate the essentials of the universally accepted dictums.

Factors Influencing Deterrence

Popularly, the 'theory of rational deterrence' is used to analyse the conditions under which conventional deterrence is likely to succeed or fail. Alternative theories are there that focus on "organisational theory" and "cognitive psychology". But the theory of rational deterrence is most appropriate in context of South Asia. Deterrence is more likely to succeed if a defending State's deterrent threat is credible to an attacking state. PK Huth outlines that a threat is considered credible if the defending state possesses both the military capabilities to inflict substantial costs on an attacking state in an armed conflict, and if the attacking state believes that the defending state is resolved to use its available military forces.

Bruce Jentleson[7] argues that two key sets of factors are important for successful deterrence. They are the defending state's strategy that balances credible coercion and deft diplomacy, consistent with the three criteria of proportionality, reciprocity, and coercive credibility, and the extent of an attacking state's vulnerability as shaped by its domestic political and economic conditions. A successful deterrence policy must be considered in not only military terms, but also in political terms. If armed conflict is avoided or unpalatable concessions made at the price of diplomatic loss then it cannot be claimed that deterrence has succeeded.

Deterrence Paradox

Analysts of South Asian security have drawn attention to at least three paradoxes that will impact the success of deterrence in the case of India-Pakistan. They are the stability-instability paradox, the vulnerability/invulnerability paradox and the independence/ dependence paradox.

The stability/instability paradox implies that the probability of a direct /general war between two nuclear-armed states greatly decreases due to these weapons, but the probability of minor/ indirect/limited conflicts between them increases. Its impact is seen in the India-Pakistan context, with the ongoing proxy war being waged by Pakistan in the state of J&K and the Kargil war of 1999,

which remained localised in spite of the provocation, primarily due to the restraint exercised by India.

The vulnerability/invulnerability paradox refers to the increased risks of unauthorised use, accidents and theft of nuclear assets that arise from attempts to secure them against pre-emptive strikes. Scott Sagan, a professor of political science at Stanford University, states that the vulnerability/invulnerability paradox requires, that a tactical nuclear weapon will have to be in a constant state of readiness, with corresponding problems of devolution of control. This in turn leads to questions about Pakistan's ability to control escalation dominance, given the suspected Islamist infiltration of the Pakistani military and alleged split between the higher command and lower cadre. In addition, the workings of the Pakistan's SPD are little known, generating further doubt about the safety of the country's nuclear arsenal.

The dependence/independence paradox refers to the inability of the feuding nuclear rivals to effectively manage situations of crisis without the involvement of the third parties. The Kargil war is an example wherein behind the scenes coercion was exercised by the US on Pakistan. According to Sagan, some States that have nuclear weapons don't see them as a deterrent but as a shield behind which they can take more aggressive action. "If some militaries think war is inevitable in the long term they believe they can engage in preventive war. And if they think nuclear weapons are a good deterrent, it also gives them the incentive to use force at lower levels." Sagan also remarks that such posturing was not witnessed even during the Cold War. But, we see this often between India and Pakistan, most notably during the Kargil conflict and even later.

Therefore, the threat of introduction of battlefield weapons by Pakistan in South Asia, with the testing of Nasr and introduction of 350 kms, Ra'ad cruise missile which are difficult to intercept and destroy, will add to strategic instability in South Asia.

Analysis and Recommendations

Impact of Pakistan's TNWs. The undermentioned pointers would summarise the contextual issues :-

(a) The induction of SRBMs by Pakistan is based on their conviction that the same would strengthen their 'minimum

credible nuclear deterrence'. The Pakistan hierarchy is convinced that this would reduce space for a full-fledged conventional conflict from taking place in the region.

(b) The short range weapon system could facilitate in addressing the existing void of a weapon to demonstrate its resolve to use nuclear weapons, once India crosses its 'Red Lines'.

(c) It is questionable if TNWs will increase deterrence and obviate chances of limited conflict, but yes the availability of TNWs will give Pakistan the means to indulge in brinkmanship and exploit the card of irrationality to strengthen and reduce the threshold of nuclear deterrence.

(d) In the operationalisation stage, storage of these TNWs once manufactured, will create corresponding security concerns, in the unstable internal security environment within the country.

(e) As highlighted earlier the TNWs once released for deployment during conflict will create the dilemma of 'use them or lose them' for the commander and increase the probability of premature release.

(f) There will be negative ramifications/complexities in the bilateral relations of Pakistan with Iran and Saudi Arabia.

(g) There is a correlation of deterrence and strategic stability with political, economic and military factors unique to South Asia. A weak/failing state with fragile internal security environment shall weaken the impact on deterrence; and this is applicable to Pakistan.

Does India need TNWs?

Development of TNWs would violate India's principle of 'credible minimum deterrence posture', which does not concentrate on the numbers game, but on developing minimum survivable nuclear weapons. In addition, the induction of TNWs will demand a relook at the present policy of NFU. Presently NFU and explicit mention of 'massive retaliation' in its nuclear doctrine is a stabilising element and places lesser burden on the minimalistic command and control systems in place in the Country. A decision to develop the TNWs

will also lend credibility to Pakistani thinking of graduated response in nuclear war fighting.

Also, as stated earlier, the existing deterrence and strategic stability amongst the two nations is being exploited by Pakistan to continue its proxy war against India**.** Therefore, introducing TNWs by India in response, with corresponding lowering of nuclear threshold, will further embolden Pakistan to increase the ongoing proxy war in intensity and enlarge its footprint from the Valley to other parts of the State.

India's Options

Irrespective of what is considered a TNW, or whether Pak has the capability today or can develop it in a realistic time frame, to whether TNWs will curtail space for conventional conflict or not, or is it to impact the perception**/**psyche of the Indian leadership or it is to give teeth to its existing nuclear policy of a weapon for signalling, the reality is irrefutable evidence of Pakistan's resolve to develop nuclear war fighting capability.

India, therefore, cannot be a silent spectator to the unfolding events in Pakistan, but needs to study the impact of introduction of battlefield nuclear weapons. It would require making the existing system of handling cum operationalisation of the strategic nuclear weapons more robust and addressing existing voids/shortfalls in the intelligence, surveillance and reconnaissance (ISR) capability/ early warning systems and the command and control elements.

India should not accept a differentiation in the 'genre' of nuclear weapons and continue insisting that a "nuke is a nuke" and deal with it in consonance with the present doctrine. This is based on the premise that explosion of a nuclear device/ weapon has strategic ramifications as it results in horrendous collateral damage, especially in our context.

Prior to any review of the existing nuclear doctrine and formulation of future strategy to meet this new challenge, India will have to keep the undermentioned aspects in mind:-

(a) The primary focus of review of the policy has to be China and thereafter, it be vectored for the western front. It is not feasible to have separate policies for our neighbours.

(b) There is a need for synergising the application of our conventional combat resources. Presently, these are operating in independent silos, be it the three Services and the Strategic Forces or the Armed Forces and the Central Police Forces. The straitjacketed silos and 'turf protection' by each service have negative ramifications. There is, therefore, an essential requirement to create the long awaited post of Chief of Defence Staff (CDS)/ Permanent Chairman Chiefs of Staff Committee to be the single point authority for synergising the armed forces and the strategic assets.

(c) The structures of the National Command Authority need to be stitched and the doctrine harmonised. The NFU demands foolproof measures for protection and survivability of our strategic nuclear assets.

(d) The signalling and command, control, communications, computers, intelligence, surveillance and reconnaissance (C4 ISR) are not as robust as they should be. Thus, the 'credibility' of our response is questionable more so, in case of induction of TNWs in South Asia.

(e) There is a need for in-house changes within the armed forces for empowering the senior leadership with the requisite skills to handle these responsibilities without diluting the required secrecy.

(f) Improve the intelligence and surveillance architecture to have a 24 x 7 capability to monitor the Pakistani airspace, catering for short range nuclear weapons, with very short time of flight.

(g) There is a need to add ambiguity to our Nuclear Doctrine. This can be done in a variety of ways, be it by qualifying the policy of NFU or building up perceptions through our writings/ appropriate signalling.

(h) There is a need for India to develop 'Launch on Warning (LOW)' and 'Launch under Attack (LUA)' capabilities, backed by an effective BMD system. This will enhance/add a required dimension to its existing capabilities.

Signalling is also required at the working level while it is done at the politico-diplomatic level. Therefore, at the operational level

there is a need to convey India's intent to wage conventional conflict, irrespective of the threat of TNWs. This is possible by subtle publicity of on-going modulation/honing of the existing nuclear, biological and chemical (NBC) countermeasures and organisations within the armed forces, including acquisition of personal protective clothing and collective decontamination kits. Also, the present training measures that are in vogue within the armed forces, with respect to continuing operations through TNW attacks need to be publicised. This would be the best measure to tackle Pakistan's brinkmanship. Simultaneously, national institutions, like the National Disaster Management and civil defence organisations in various states should carry out periodic practice drills, to meet the challenge of dealing with such attacks in inhabited areas. There are other operational considerations which if adopted would deter Pakistan from crossing the Rubicon but these lie in the military field and need not be discussed here.

The two other aspects of our nuclear doctrine that always come under debate are the policy of 'massive retaliation' and NFU. There is no doubt that one of the key factors for 'strategic stability' in the subcontinent is India's stated policy of NFU. There are no reasons, at least for the time being, to affect a change in this policy.

However, there are cynics who question India's policy of 'massive retaliation'. There is no doubt that the signalling of this critical aspect has been inadequate and has impinged upon the 'Credibility' aspect of deterrence. The reason is that over the years we as a country have not exercised the hard options, when Pakistan has transgressed the line of respectability, till recently. It is for this reason that our policy of 'massive retaliation' in case of a nuclear attack is considered weak/unrealistic. This inadequacy will have to be rectified through sustained and appropriate actions at all levels.

Conclusion

I will conclude by stating that the testing of 'Nasr' and the contextual rhetoric does not presently warrant a review of India's Nuclear Doctrine and India should not even consider acquisition of TNWs. However, there is a need to put in place a real time and effective mechanisms to monitor Pakistan's activities in the techno - politico -military realm with respect to TNWs. Simultaneously, India needs

to make its nuclear systems more robust, reliable and fail-safe, with the ISR systems modulated to pick up short range nuclear tipped missiles.

Endnotes

[1] NATO/Russia Glossary of Nuclear Terms and definitions, http://www.nato.int/docu/glossary/eng-nuclear/index.htm

[2] Feroz Khan, "Challenges to Nuclear Stability in South Asia," The Non Proliferation Review 10, No1, Spring 2003, p 65

[3] Flexible response was a defense strategy implemented by John F Kennedy in 1961 and called for mutual deterrence at strategic, tactical, and conventional levels, giving the United States the capability to respond to aggression across the spectrum of warfare, not limited only to nuclear arms.

[4] Shaun R Gregory, *Nuclear Command and Control in NATO,* London Macmillan Press 1985, pp 3-4

[5] Gurmeet Kanwal, Command and Control in the context of TNWs, Ch 6,pp 119, *Pakistan's Tactical Nuclear Weapons.* Quote Stephen Twigge and Len Scott, "Learning to Love the bomb: The Command and control of the British Nuclear Forces, 1953 - 1964", *The Journal of Strategic Studies,* Vol 22, No 1, March 1999.Unquote

[6] Pakistan seems to have improved the safety and security of their nuclear weapons, by implementing the 'two-man rule' while installing Permissive Action Links (PALS), and ensuring that warheads are de-mated from their delivery systems during peace time.

[7] Professor of public policy and foreign affairs, at Duke University.