NuClearly Put

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Survivability of Nuclear Arsenal – What? How?

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In earlier issues of the *NuClearly Put* series, I have often mentioned the importance of the survivability of nuclear arsenals for credible deterrence. I have argued that rather than worrying about nuclear warhead numbers, the focus of India's capability build-up must be on ensuring the survivability of nuclear assets to let the adversaries know that they have no credible chance of carrying out a decapitating or disarming first strike.

'Survivability' involves developing capabilities, establishing systems, adopting procedures, and building organisations that are capable of mounting convincing threats of assured nuclear use even after taking a nuclear hit. This is particularly important for a country with a no-first-use (NFU) doctrine since it must signal the certainty of retaliation, which is possible only if the requisite capability and the resolve to use it can survive a first strike.

Ensuring survivability is a complex and multi-pronged exercise. Intuitively, one would think that the easiest way to ensure survivability would be to build a large arsenal so that some of it would survive a first strike. But, in reality, the calculations of what, how, and how much to make 'survivable' must be based on a complex matrix of the strengths and vulnerabilities of self and adversary.

What should be made survivable?

It is natural that a country undertaking nuclear first use would seek to degrade either one or both of the following kinds of targets: first, the adversary's nuclear forces, such as weapon storage sites, missile silos, submarines, bomber bases, command and control nodes, etc., in order to degrade the country's ability to mount retaliation; second, the adversary's political will or determination to retaliate by undertaking counter-value strikes in the hope that the politico-psychological impact of nuclear attacks on population centres would paralyse decision-making, thereby reducing chances of retaliation.

Given the above, it is obvious that many elements need to be made survivable. Of course, the atomic bomb is at the heart of the matter and must survive for 'nuclear' retaliation to be mounted. But the survivability of the bomb alone cannot suffice. Credible deterrence demands the survivability of other enabling mechanisms and supporting structures too. For example, the nuclear weapon or its delivery mechanism would mean little in the absence of a living and able decision-maker at each level in a clearly defined chain of succession. Another essential pre-requisite would be a command-and-control system that provides timely and relevant inputs to the decision maker and a communication network that carries the decision down to the man in the field who is to execute the launch, besides providing him accurate targeting coordinates and other supporting logistic elements.

However, most importantly, the will to undertake retaliation must survive. The availability of others would be meaningless in its absence. While mathematical modelling can help calculate the chances of survival of tangible, quantifiable components, nothing can guarantee, or even exactly assess, the survival of political will. For instance, the news of high-level nuclear damage could either send the decision-maker into a state of shock and lead to action paralysis, or it could lead to immense anger and immediate action. Low damage from a nuclear attack could also make the decision-maker more susceptible to external pressures. The nature of the target of the attack could also influence the mental frame of the decision-maker. An isolated nuclear attack on an air base, a surface ship out at sea, or in a remote desert army unit would, in all certainty, affect the decision maker differently from a situation in which the adversary has mounted multiple counterforce attacks coupled with some countervalue ones too. In this context, it becomes extremely important for the political leadership to adequately understand and appreciate the intricacies of nuclear deterrence breakdown. Periodic briefings to those in the command chain are important requirements in this regard.

How to ensure survivability?

Nations make choices on how to ensure survivability based on considerations of their geography, technological capability, political system, and financial resources. While information on the exact *modus operandi* is mostly classified, some transparency is also important for enhancing deterrence.

An intelligent approach towards survivability would ideally be an optimal mix of measures such as secrecy, deception, dispersion, concealment, mobility, and defences. The determination of how much to conceal and where, or what to make mobile, and how and what to geographically disperse must be based on a cost-benefit analysis that takes the adversary's and one'sown advantages and limitations into account.

Secrecy

Limiting access to information about the extent and location of nuclear assets by restricting information and hiding the identity of those who know is one of the simpler and low-priced ways to ensure survivability. In fact, this tactic is used to build a level of opacity by keeping few people 'in the know' and by indulging in perception management on matters nuclear.

In the case of India, maintaining secrecy has deep historical and cultural roots. In the caste-based system, monopolising knowledge was the norm. The bureaucratic system developed by the British, as it exists today, also routinely uses secrecy. Most strategic organisations work on a 'need to know' principle. While this mode of functioning can hamper the development of a more formal and institutionalised system, it does enhance security. As explained by Ashley Tellis, "Since the entire organisational structure places a premium on extreme secrecy… potential adversary has to reckon with the prospect that there could always be some further strategic capabilities or technical resources held in reserve… unknown even to those few individuals otherwise thought to possess 'perfect' knowledge about the status and disposition of India's distributed strategic assets." [1]

Deception

If secrecy is a passive measure for increasing survivability, deception is an active method to deliberately mislead through the wilful communication of false information or by fomenting ambiguity

through contradictory statements. For instance, Soviet President Brezhnev contributed to the myth of a 'missile gap' in favour of the USSR when he said his country was producing missiles like sausages, even though the reality was different.

Besides verbal misinformation, deception can also be practised by building dummy missiles or launch and storage sites in order to multiply targets and reduce the adversary's confidence in a first strike that can hit all or even all the correct targets. In fact, this can be an effective and relatively inexpensive way of ensuring survivability, especially for delivery vehicles. China seems to be playing such a shell game of deception with the US by building silos that may or may not be populated by nuclear missiles.

Physical and EMP Hardening

Building customised physical structures with special materials that can withstand nuclear attack is another way of ensuring the survival of critical assets. It entails constructing structures, systems, and components to tolerate exposure to the effects of nuclear detonation, such as air blast, ground shock, electromagnetic pulse (EMP), heat, pressure, and radiation.

Hardened structures, however, are expensive and difficult to build, given the need for special materials and other considerations. In the case of missile silos, it would also involve hardening not only the physical outer structure but also constructing exact spaces for hosting nuclear assets in such a manner that even individual components can withstand violent ground motion. Power supplies, communication, and launch control electronic hardware of the delivery vehicle also need to be protected against thermal effects, ionospheric disruptions, and radiation effects.

Besides nuclear warheads and delivery storage, another component of the nuclear arsenal that requires hardened structures is the Nuclear Command Authority (NCA) and the Nuclear Command Post (NCP), as well as their alternates. The NCA is the decision-making body comprising the Prime Minister and other cabinet ministers tasked with the responsibility of authorising nuclear use. The NCP, meanwhile, is a robust communication centre with the ability to receive information and disseminate it. Gen Sundarji distinguished the two as, "If NCA is the brain, the NCP is the nervous system including the sensory functions."[2] Obviously, the survival of both is essential for retaliation. In fact, knowledge of the measures taken to ensure survivability of such structures would

not only provide confidence to one's own side but also let the adversaries know that they could not hope to carry out a decapitation strike.[3]

Despite the importance of hardened structures, it must also be recognised that several factors impinge on their efficacy. First, their location has to be carefully considered, keeping the range of the adversary's missiles/aircraft in mind. Second, the level of hardening would also need to take into account the adversary's warhead and delivery accuracies. Thirdly, modern intelligence, surveillance, and reconnaissance (ISR) capabilities that make detection easier and the development of highly accurate missiles that enable accurate counterforce targeting can erode confidence in fixed installations. Therefore, depending only on hardened structures cannot be possible given their cost, complexity, and vulnerabilities, which are likely to increase with incorporation of new technologies.

Mobility

One way of circumventing the vulnerability of nuclear assets in fixed structures is to make them mobile on an elaborate road and rail network. This would complicate the adversary's ability to constantly monitor and accurately target these forces. This could be made more complex by adding dummies to the actual mobile forces.

However, two technological developments can constrain mobility: first, the ability to reconstitute forces quickly after an attack. If the assets are too widely dispersed, it might prove to be logistically difficult to quickly bring them together for retaliatory launches. This challenge, however, is not insurmountable and can be overcome through detailed pre-planning and the conduct of periodic drills to understand and overcome limitations; the second constraint arises from the need to ensure secure, hardened, and sufficiently redundant communication lines. Their absence or disruption could cripple the retaliatory system by making it difficult for mobile units to link up with one another or the NCA. Therefore, adequate attention must be paid to make these survivable so that the benefits of mobility can be maximised.

In fact, it also needs consideration whether the NCA/NCP should themselves be made mobile, either on an airborne platform or on land transportable vehicles. With the acquisition of an Airborne Warning and Control System (AWACS) and with aerial refuelling capabilities, India does have the possibility of making the command post airborne in crisis situations. Meanwhile, mobility on land is also offered by India's extensive rail and now modern road networks. There would be a

requirement for specially constructed camouflaged vehicles (whether rail bogies or road carriers). These will also need sufficient reserves of power to run complex data and communication systems, sufficient fuel for adequate movement, and other logistic requirements to ensure independence of movement. Given India's variegated terrain of mountains, forests, and the expansive Deccan plateau, air, rail, or road mobility could offer options for the survivability of the NCA/NCP. Pre-planning with adequate forethought can offer possibilities of redundancy, thereby ensuring a sanctuary for the national leadership to survive an attack, assess damage, and exercise retaliatory options.

Dispersion

Dispersal of nuclear assets to ensure their survival can be done in two ways: one, these could be geographically distributed over several locations in such a way that no complete strategic systems exist as transparent targets. In fact, that is the state in which the Indian nuclear doctrine mandates the forces normally be maintained to be brought together as "fully employable forces" only in case of a crisis. This proffers the obvious advantage of multiplying targets to complicate adversary calculations. As was explained by Gen Sundarji, "It is not just a question of [finding] 'needles in haystacks' but parts of many needles in many haystacks which might be brought together when required within hours to days, to form full needles in yet many more different haystacks".[4]

Of course, such dispersal poses the challenge of timely and effective reconstitution of the nuclear force during a crisis. It is normally assumed that any crisis between India and Pakistan or India and China would gradually develop over a period of time. Therefore, components of the nuclear force would have to be brought together in a period of ongoing conventional operations. The movement of nuclear assets during such a time would face challenges of their own. It would call for elaborate planning and coordination among different agencies to remain networked to ensure safe passage on every mode of transportation likely to be used.

A second method of dispersion is by spreading the nuclear assets over a range of delivery platforms. Historically, every state with nuclear weapons has used air delivery as the first option because of its ready availability. However, given the restricted range of aircraft and their limited penetration capabilities in a dense air defence environment, missiles – land-based and sea-based – have evolved as the preferred option. While mobility is an important aspect of land-based

missiles[5], the highest level of survivability is nevertheless ensured by placing nuclear-tipped missiles with sufficient ranges on nuclear-powered submarines (SSBNs).

Predictably, sea-based deterrence is not without its own set of difficulties. For India, the construction of SSBNs has been particularly challenging given that the country has had to undertake a completely indigenous development of the vessel under technology denials, including dual-use materials and technology. Also, since the country's nuclear energy programme has been based on the development of pressurised heavy water reactors instead of pressurised water reactors, the technology best suited for nuclear submarines, the country has had to develop a parallel track of technology for the SSBN reactors. Also challenging has been the development of submarine-launched ballistic missiles of adequate ranges. Another critical requirement of sea-based deterrence is the development of secure, constant, and reliable channels of communication with the submarine. Normally, underwater communications are possible through the extremely low frequency (ELF) bands of the electromagnetic spectrum. These, however, have a restricted data-bearing capacity and are slow. Also, their transmitting stations are large, fixed, and difficult to harden, making them vulnerable to a first strike. The US resolved this problem by having an airborne very low frequency (VLF) system coupled with satellite communications or by developing ELF communications. India, too, will have to find its own answers to this problem.

Another challenge to SSBNs is seen from improved anti-submarine warfare (ASW) capabilities. Since SSBNs carry concentrated clusters of strategic capabilities (at least 12-16 multiple independently targetable reentry vehicle [MIRVed] missiles, their loss could be substantive. SSBNs are also most vulnerable when in port since they are difficult to hide. In the case of India, this problem is exacerbated by the non-availability of too many ports that could host the SSBNs, making their targeting by the adversary relatively simple. Also, unlike land-based nuclear capabilities that can be maintained in a distributed form, a sea-based deterrent presupposes complete systems on board at sea.

Despite these challenges, sea-based deterrence still offers enough advantages to be a viable and effective option for enhancing survivability. Indeed, for a peninsular nation like India, the vast seas around it provide large areas where SSBNs could remain hidden with a significant nuclear arsenal for long periods of time to mount retaliation if and when necessary. In fact, the credibility of a counterstrike is ensured once an adversary knows that a fully armed SSBN is out at sea.

Active defences

The deployment of air and missile defences around critical points is another way to ensure survivability. Point or area-specific missile defences can intercept incoming enemy missiles and neutralise them before they hit the target, thus ensuring the survival of what they are meant to protect. However, there can be little guarantee that every incoming missile will be intercepted in time. The financial and technological costs and complexities of building defences are not trivial either. Moreover, simple countermeasures can defeat ballistic missile defence (BMD), and it is relevant to point out that in the Indian case, this is especially important since China, over the last decade, has concentrated on developing effective countermeasures to defeat the far more sophisticated BMD of the USA.

For India, erecting point or area defences over some types of nuclear assets such as early warning systems, air bases for nuclear-capable aircraft, command posts, submarine communication centres, nuclear production facilities, and launch or storage sites in cases where mobility is not enabled is a feasible option. However, the erection of BMD over critical points has the disadvantage of exposing locations to the adversary, thereby subverting the advantage of concealment. This trade-off will have to be carefully considered.

Survivability is achievable through a number of measures. The challenge lies in making the right choices based on relevant parameters. The first set of these must be an assessment of the adversary's ISR, target acquisition, and strike capabilities. For instance, in order to evade the better human intelligence capabilities of the adversary, it would be necessary to maintain a high level of secrecy regarding information about assets and their locations, capabilities, etc. Compartmentalisation of information within government, armed forces, and even strategic organisations would be necessary, besides elaborate and sophisticated personnel reliability programmes in every establishment and at every level.

On the other hand, a higher adversarial capability of peeping into one's own territory through technical surveillance would entail greater emphasis on deception and mobility. Or, the capability of the adversary to conduct effective electronic warfare would imply placing greater emphasis on making own communication networks more secure and redundant. Evidently, consistent monitoring of the adversary is necessary to tweak one's own survivability of nuclear assets for the sake of credible deterrence.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])

Notes:

[1] Ashley Tellis, *India's Emerging Nuclear Posture: Between Recessed Deterrent and Ready Arsenal* (Santa Monica: RAND, 2001), p 422.

[2] Gen K Sundarji, *The Blind Men* of Hindoostan (New Delhi: UBS Publishers Distribution Ltd, 1993), p. 89.

[3] In the case of the USA, it is well known that the National Military Command Centre (NMCC) is situated under the Pentagon and the Alternate NMCC beneath Raven Rock mountain in Pennsylvania. The US also maintains an airborne command center or the National Emergency Airborne Command Post. In the UK, the Primary Command Centre, codenamed Pindar, is located beneath the MOD building in Whitehall and is connected by underground tunnels to Downing Street. The alternate PCC is an underground complex at Hawthorn near Bath.

[4] Gen Sundarji, "Indian Nuclear Doctrine –I: Notions of Deterrence", as cited in Ashley Tellis, n. 1, p. 426

[5] Interestingly, the USA, given the luxury provided by its geography and the nature of its threat perceptions, has not built any land-mobile missiles.

Recommended Readings:

- Ashley Tellis, *India's Emerging Nuclear Posture: Between Recessed Deterrent and Ready Arsenal* (Santa Monica: RAND, 2001).
- Gen K Sundarji, *The Blind Men of Hindoostan* (New Delhi: UBS Publishers Distribution Ltd, 1993).
- Manpreet Sethi, *Nuclear Strategy: India's March towards Credible Deterrence* (New Delhi: Knowledge World, 2009).
- Austin Long and Brendan Rittenhouse Green, "Stalking the Secure Second Stike: Intelligence, Counterforce, and Nuclear Strategy", *Journal of Strategic Studies,* vol. 38, Nos. 1-2, 2015, pp 38-73.