CHAPTER 10

SMALL NUCLEAR POWERS

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INTRODUCTION

Why might it be useful to examine how small nuclear powers (SNPs) consider nuclear deterrence and use? Much of the burgeoning literature on SNPs is concerned primarily with the effects on nuclear proliferation. It focuses on how the behavior of SNPs (testing, development, deployment, and nuclear trade) may adversely affect the antiproliferation norms, treaties, and regimes established over the last 30 years. The new domino theory addresses how SNPs may encourage or compel other states to acquire or develop nuclear weapons. As important as that literature is, however, deterrence failures would have more catastrophic effects. This chapter evaluates how SNPs may use nuclear weapons for deterrence and, should deterrence break down, in actual military operations. The four SNPs under consideration here are Israel, India, Pakistan and South Africa (while it had them).

Most of the remaining literature assumes that SNPs adhere to a similar deterrence policy. While not always specific, the assumption seems to be that SNPs must have developed a variation on a minimum deterrence policy, based on a smaller, more limited version of Mutual Assured Destruction (MAD), a mini-MAD.[1] Since SNPs invariably have relatively small nuclear arsenals, or at least small in comparison to superpower arsenals or second tier nuclear powers like France, Britain, and China, they are constrained to adopt a mini-MAD deterrent. That is, they have adopted nuclear policies that demand countervalue, city-busting targeting simply as a last resort, if even that. Some suggest that the mere possession of nuclear weapons by a SNP confers "existential deterrence," a de facto deterrence realized through the mere potential for, or possession of, nuclear weapons.

Uncritical acceptance of the idea of mini-MAD produces myopia about how SNPs may use nuclear weapons. Oddly enough, deterrence theorists who hold to some form of MAD may be too optimistic about the improbability of war, precisely because of its potential catastrophic consequences. The opposite approach, believing that war is inevitable and will entail nuclear warfighting, produces its own myopia about how SNPs consider nuclear deterrence. A better approach to the subject is based on prudence. As Owen Harries noted some time ago:

> Both a consistent worst-case and a consistent best-case mentality interfere with the ability to see things as they are. But there is a difference. The characteristic error associated with the former is the taking of unnecessary measures to meet problems which do not arise (though, even then, there is always the question of whether they would have arisen had not action been taken). The characteristic error associated with best-case thinking, on the other hand, is the failure to take measures to cope with problems that *do* arise [emphasis in original]. The first is likely to be wasteful; the latter may be fatal.[2]

MAD may have problems when applied to SNPs. Assured Destruction (AD), as viewed by Robert McNamara during the 1960s, imposed fairly heavy requirements for nuclear forces in deterring a Soviet attack. U.S. nuclear forces were required to absorb a well-executed surprise attack and respond with unacceptable damage on the Soviet Union. That level of unacceptable damage was calculated to be the destruction of nearly 50 percent of Soviet industry and casualties of up to 25 percent of the Soviet population. The calculus of damage was based on the United States having 400 equivalent megatons available for delivery on Soviet cities after degradation from the surprise attack and accounting for the reliability of delivery systems and their ability to penetrate Soviet defenses. AD was mutualized (MAD) for similar levels of destruction on both sides. However, it is unlikely SNPs will ever get to those levels of destruction. Even in the worst case of an all-out Indian-Pakistan nuclear exchange, terrible as it would surely be, the level of destruction fails to come even remotely close to the expected level of destruction under MAD.[3]

Deterrence policies have another problem. States that announce a deterrence policy do so in order to convince their opponents not

to initiate war in the first place. That is to say, deterrence is largely a psychological phenomenon.[4] However, deterrence policies are public declaratory policies, and often differ substantially from the targeting plans a military force develops for the use of nuclear weapons in war (the action or employment plans). For instance, late in the Johnson administration, after McNamara had enshrined MAD as U.S. policy, only about 7 percent of U.S. nuclear weapons were targeted on Soviet cities.[5] In other words, despite the public rhetoric about destroying tens or hundreds of Soviet cities in a nuclear annihilation, Soviet cities were (a) only a small fraction of the target set, and (b) targets of last resort. There are good reasons to believe that SNPs are struggling with the same gap between their public policies and their internal military plans.

While commentators frequently acknowledge that it is too simplistic to impose Cold War ideas of nuclear deterrence on emerging nuclear powers, it is a hard habit to shake. Viewing SNPs through the prism of MAD and/or related deterrence ideas has its problems. Such theories tend to be deductive in form.[6] Theories of deterrence hold axiomatically to the Rational Actor assumption about state behavior and choices with respect to nuclear weapons. Rationality assumes a pure "cost/benefit" analysis with perfect information that ignores or downplays individual differences among states.[7] According to "rationality" in deterrence theory, the costs of nuclear use will always outweigh any conceivable gains. While not disparaging of the utility of such an assumption, by definition it ignores how individual state leaders, bureaucracies, beliefs, and ideologies shape nuclear strategies. Indeed, it imposes a uniform calculus on very different actors with very different strategic "personalities."[8] Further, an assumption of rationality is, by definition, not necessarily true. The criterion for employing such theoretical assumptions is whether they are useful. The usefulness of the assumption of rationality has been challenged.[9]

If it is problematic to view SNPs through the prism of western deterrence theory, it is not a problem that SNPs make, though they make a share of their own. Frequently, analysts, politicians, and strategists for SNPs assure us that they have learned much from our literature and experience, and will not make similar "mistakes." It

therefore behooves us to first understand how policymakers in SNP countries understand themselves, their deterrence requirements, and their articulation of plans.

The approach taken here is primarily inductive rather than deductive. A series of questions guides the review of how SNPs are talking about themselves, their deterrence requirements, and their deterrence postures. The questions are designed to tease out the different ideas SNPs have considered in designing their deterrence preferences. Rather than assuming a uniform deterrence calculus based on "rationality," this approach tries to capture the preferred values that key policymakers and military strategists see for their own nuclear forces.

The questions are:

> How do SNPs perceive their own views on deterrence and nuclear use? What kind of deterrence doctrine, if any, has been publicly established?
>
> Does the emerging SNP literature on nuclear weapons envision a continuum for nuclear weapons use? If so, what is it?
>
> What are the threats to the SNPs, and how do those threats impact the development of nuclear weapons?
>
> Does it matter whether a particular state has civilian or military control over nuclear weapons?
>
> What are the research and development trends for the delivery of nuclear weapons that may signal changes in deterrence posture?

The results of this study are suggestive, not conclusive. This is due in no small measure to the absence of enough data to make determinations with a high degree of certainty. Another difference from the Cold War is found here. During the Cold War, the data on the respective arsenals, the doctrines that guided them, and public declaratory statements (along with publicly available records on arms production at least for the United States), made calculations of the deterrence relationship fairly simple. If that seems odd, given the enormity of the nuclear arsenals and variety of delivery systems of the United States and the Soviet Union during the Cold War, consider that with the exception of the Republic of South Africa, we have no certain data on the number of nuclear weapons by the other three SNPs considered here. Debate still rages over how many weapons, if actually produced and weaponized, are deliverable. Moreover,

the delivery systems for the most part are far less advanced, and their reliabilities therefore are more difficult to calculate. Only India published a draft nuclear doctrine and subsequently an "operationalized" nuclear doctrine, but it contradicts its officially declared deterrence policy. Israel's official nuclear policy remains opaque. Finally, whereas Pakistan's nuclear policy is India-centric, India argues that its nuclear forces are primarily for China; Israel has—and South Africa had—no nuclear neighbors. There can be no mutuality (the M in MAD) without nuclear neighbors.

Nonetheless, some hypotheses may be proposed. First, it seems clear that these four SNPs all hold to a richer view of nuclear deterrence than a simple mini-MAD deterrent theory suggests. Second, all four see a use for nuclear weapons that is at least as broad as that viewed by the superpowers during the Cold War, though adapted to local conditions. Third, all have some idea of how they might use nuclear weapons on the battlefield, or at least have considered their use. This last hypothesis most directly contradicts the mini-MAD deterrence paradigm. While it does not prove that SNPs will use nuclear weapons on the battlefield, or that deterrence will necessarily break down, it at least suggests that Western observers ought not ignore how SNPs view themselves. In crises, political leaders tend to turn to those ideas and habits developed in calmer times. There is little to suggest that SNPs would do otherwise.

It does suggest, however, that non-nuclear powers should look skeptically on the acquisition of nuclear weapons. While some deterrence theorists argue that acquiring nuclear weapons brings greater security and peace of mind, the short history of small nuclear powers tells a different story. Acquiring nuclear weapons means acquiring a whole host of new problems, even greater than the problems of not having them. Trying to figure out how to secure them, use them, or lose them are among only a few of the numerous problems that attend such weapons. More importantly, having nuclear weapons means having to consider how to defend against them, and how to rebuild society should deterrence fail; neither consideration is easy.

THE REPUBLIC OF SOUTH AFRICA

The Republic of South Africa's (RSA) nuclear program is an oddity in international politics. It remains the only state that developed nuclear weapons and subsequently dismantled them.[10] Though there is still debate on exactly when the RSA decided to produce militarily useful nuclear weapons (sometime in the early to mid-1970s), there is no doubt as to when it officially gave them up. By all official accounts, the RSA completely dismantled its nuclear weapons and related infrastructure by June 1991. On July 10, 1991, the RSA acceded to the Treaty on the Non-Proliferation of nuclear weapons (NPT), and by September 16, signed full-scopes safeguards with the International Atomic Energy Agency (IAEA). For many, RSA's actions are a model for reversing proliferation.[11]

Scholars debate why the RSA got into the nuclear business.[12] Some argue that the RSA's security situation is sufficient to explain its decision. Others believe that the regime's internal weaknesses also contributed. Still others argue that nuclear capability development was based on Pretoria's belief that South Africa was part of the western European security culture. When Europe and America began to distance themselves from South Africa's apartheid policies, the regime's sense of insecurity increased dramatically. Without settling the differences in scholarly approaches to the subject, or the peculiar theories employed to prove them, it is sufficient to note that all of the factors above helped shape the regime's decision.

The mid-1970s were troubling for South Africa. The security situation of South Africa grew more complicated when Portugal withdrew from Africa after the 1974 Lisbon coup. Subsequently, communist governments emerged in Angola and Mozambique. At the same time, western governments began disassociating themselves from the RSA's policy of apartheid, particularly the United States, under the administration of President Jimmy Carter. Finally, Soviet support for regional enemies through the use of proxy forces rattled Pretoria's leadership as well. Former State President of South Africa Mr. F. W. de Klerk testified:

> The decision to develop this limited [nuclear] capability was taken . . . against the backdrop of a Soviet expansionist threat in Southern Africa, as well as prevailing uncertainty concerning the designs of the Warsaw Pact members.

> The build-up of the Cuban forces in Angola from 1975 onwards reinforced the perception that a deterrent was necessary, as did South Africa's relative international isolation and the fact that it could not rely on outside assistance should it be attacked.[13]

By the late 1980s, however, South Africa's security situation had improved considerably. De Klerk noted that when he became president in 1989, a cease-fire in Angola had been agreed upon. In December 1988, a tripartite UN agreement provided for the withdrawal of 50,000 Cuban troops from Angola. And, finally, the Cold War began winding down with the destruction of the Berlin Wall and the collapse of the Warsaw Pact. As de Klerk's administration began reforming its policy of apartheid and sought greater cooperation with neighboring African states, it determined that "a nuclear deterrent had become not only superfluous but, in fact, an obstacle to the development of South Africa's international relations."[14]

In 1993, de Klerk testified to Parliament of South Africa's secret nuclear weapons program. He indicated that the RSA had dismantled its nuclear weapons program and acceded to both the NPT and IAEA inspections. The RSA's original nuclear objective had been to develop seven nuclear devices, though only six were developed by the time the decision was made to dismantle them. De Clerk also averred that no advanced nuclear weapons, such as thermonuclear devices, had ever been developed. He also spelled out the RSA's limited nuclear deterrence policy. In the event of a dire threat to South Africa's existence, the RSA would confidentially inform the major powers, presumably including the United States, of its nuclear program in order to elicit (or provoke) intervention on its behalf.[15]

Waldo Stumpf, director of the RSA's Atomic Energy Corporation, explained the three phases of the nuclear deterrent policy:

> Phase I: Strategic ambiguity. The RSA would develop its indigenous nuclear weapons and prepare for any contingency, and would neither confirm nor deny its capability.
>
> Phase II: Covert acknowledgement. Should the situation deteriorate significantly, say by threats to South Africa's territory by Warsaw Pact

> countries through surrogate Cuban forces, the RSA would consider covertly acknowledging its nuclear deterrent to international powers, particularly the U.S.A.
>
> Phase III: Overt acknowledgement. Should covert acknowledgement fail to induce or provoke a major power to intervene on behalf of the RSA, the government would consider publicly acknowledging its nuclear deterrent or demonstrating it by an underground nuclear test.[16]

This "strategy" seems to have evolved from an ambiguous three-fold recommendation by a key military adviser to then Defense Minister P. W. Botha in mid-1978. Botha had requested a study on nuclear deterrence by South African Defense Force (SADF) Chief of Staff for Planning, Army Brigadier John Huyser.[17]

The actual "strategy" was a bit more nuanced. In 1983, Andre Buys, a senior scientist with Armaments Corporation (Armscor), chaired a working group of senior scientists and politicians. The group conducted war games, reviewed deterrence literature, and developed a nuclear doctrine. Phase I remained the same. However, Phase II included not only privately acknowledging RSA's nuclear deterrent, but also inviting scientists of the skeptical countries to privately examine its nuclear weapons capability and, if the guests remained skeptical, threaten to detonate a nuclear device underground. Phase III was the most ambitious, involving three steps itself. The first step would be to publicly declare its nuclear deterrent or conduct an underground test. The second step, should the first fail to elicit the desired response, would be to detonate a nuclear weapon 1,000 kilometers south over the ocean. The last step, if all else failed, would be to threaten to use nuclear weapons tactically on the battlefield.[18]

Senior RSA officials declared that in actual practice the RSA never got—nor ever intended to get—beyond Phase I.[19] They argue that the only reason for the weapons in the first place was for deterrence, however ambiguously defined. Most admitted that the actual use of nuclear weapons would be suicidal, politically and militarily, since the Soviet Union could have responded with a devastating riposte.[20] Some scholars believe the weapons were simply for blackmail diplomacy, designed solely to keep the West, especially the United States, in place as an ally in the event of dire emergency.

To support their contention, they point out that the weapons were never deployed militarily or integrated into the country's military doctrine.[21] As importantly, Buys mentioned that he and the other Armscor scientists who developed the bomb and recommended its strategy were aware of the allegations that Israel used nuclear weapons during the 1973 Yom Kippur War in order to obtain U.S. assistance. According to one scholar, Buys later wrote:

> [The Armscor working group was] aware of the alleged use by Israel of its nuclear capability . . . during the 1973 war. We had no proof that this was factual. . . . The allegation probably subconsciously influenced our thinking. We argued that if we cannot use a nuclear weapon on the battlefield (as this would have been suicidal), then the only possible way to use it would be to leverage intervention from the Western Power by threatening to use it. We thought that this might work and the alleged Israel-U.S. case gave some support to our view.[22]

Still another scholar of South Africa's nuclear program believed that South Africa's nuclear weapons "were developed without a strategic rationale."[23]

The threats to South Africa were amorphous; its possible nuclear targets were hard to imagine. South Africa had no nuclear neighbors. Its defense forces could defeat any conceivable invasion threat conventionally, even an improbable Soviet invasion force of airborne, air assault, and naval infantry forces. General Jan Geldenhuys, chief of the South African Defense Forces (SADF) from 1985 to 1990, testified that he saw no need for nuclear deterrence because such threats to invade were seen as slight probabilities.[24] About the only conceivable targets were nearby cities and Soviet naval forces offshore, since South Africa lacked capability to strike any targets at very great range.[25]

ISRAEL

Israel's nuclear policies are *sui generis*. From the beginning, Israel has kept its nuclear program a tightly held secret, even among its political leadership.[26] Its nuclear program was born and developed at a time when Arab states backed by the Soviet Union posed threats to its existence. As importantly, Israel has kept its nuclear posture

opaque to foreign observation and inspection. Observers have called it a policy of "deliberate ambiguity" or one of "opacity," though a better description may be that its nuclear program is "translucent." Enough is known about Israel's nuclear capability to conclude that it provides credible deterrence, but without enough certainty to provoke unwanted reactions.

Unlike other small nuclear powers, Israel has never given any official declaration of its nuclear policies. In fact, according to most scholars, by remaining ambiguous about its nuclear arsenal—as well as any nuclear targeting plans or nuclear doctrine—Israel reaps most of the rewards of a declared nuclear deterrent but avoids its costs.[27] The reward of translucence is existential deterrence; that is, the deterrence of a major Arab invasion of Israel proper. The costs of going public, however, could be heavy. They could include forcing the United States to reverse its nonproliferation policy or to distance itself from Israel and perhaps compel Israel to disarm. An announcement might also propel Arab states to overtly pursue nuclear weapons.

Given Israel's deliberate ambiguity, its nuclear doctrine and plans for nuclear use must be inferred from circumstantial evidence. Despite this, a number of scholars of Israel's strategic deterrent are adamant that the only purpose for Israel's nuclear weapons are for weapons of last resort—that is, a mini-MAD deterrent.[28] Others see more subtlety to its putative doctrine, including the use of nuclear weapons diplomatically, politically, and militarily, as well as a last resort.[29] The available evidence suggests that however deficient Israeli official policy pronouncements may be, the latter seems more realistic.

Of all small nuclear powers, Israel's nuclear capabilities are the most robust, advanced, and diverse. The U.S. intelligence community suspected Israel of having some 25 nuclear weapons by the early 1980s. To the community's surprise, evidence from a walk-in defector, either an Israeli scientist or technician, gave the United States its first look inside the Israeli nuclear production facility at Dimona some 5 years before the defection of Mordechai Vanunu. It is reported that the walk-in had photographs that suggested Israel had more than four times the original estimate, some 100 nuclear bombs, and that Israel had a very sophisticated program far more advanced

than originally believed. More importantly, the data the defector brought with him about the delivery systems suggested that Israel could deliver nuclear warheads with accuracies that were the equal of anything the United States or the Soviet Union had.[30] If close to true, it is fairly remarkable. In the early 1980s the United States was capable of delivering nuclear warheads to within a hundred meters of its intended target at intercontinental ranges, and to within tens of meters at intermediate ranges.[31]

By the mid-1980s, the Israeli program had advanced even further. According to a 1986 article in the London Sunday Times, a technician from Dimona—Mordechai Vanunu—provided evidence and photographs of the Israeli program. According to the expose, Vanunu's data indicated that Israel had about 200 nuclear warheads, with boosted fission devices and the capability for thermonuclear weapons. Some weapons were considered to be capable of several hundred kilotons of explosive power. Further, other scientists who evaluated the evidence believed Israel was capable of building neutron bombs (enhanced radiation warheads) and suggested that Israel had F-16 deliverable warheads and warheads that could fit on its *Jericho* missile system. Finally, Vanunu's product showed that Israel's underground plutonium separation facility produced several times more plutonium than originally thought. The sophisticated designs revealed in the photographs suggested that Israel may be capable of building nuclear bombs with as little as 4 kilograms of plutonium, which increased the estimates of Israeli stockpiles.[32]

Israel has fairly sophisticated delivery systems. According to widely acknowledged sources, Israel originally designed its long-range delivery system around the F-4.[33] Since then its strategic delivery systems have come to include the F-16, F-15, *Jericho* I and II ballistic missiles, and a variation on a cruise missile launched from a submarine. Notably, the *Jericho* II is considered to be essentially a knockoff or replica of the U.S. *Pershing* II missile deployed in Europe in the early 1980s. The *Jericho* II has an inertial guidance system, an advanced radar terminal guidance system, elements of a solid fuel propellant, and the shell of the missile itself.[34] The testing and development of the *Jericho* II in the late 1980s prompted Moscow to warn Israel that it posed a direct threat to the Soviet Union.[35] As Table 1 shows, Israel has a robust Triad of nuclear delivery systems.

	Delivery system	IOC	Range
Air-based	F-16 A/B/C/D/I	1980	1,600 km
	F-15 I	1998	4,450 km
Land-based	Lance (tactical use only)	1975	130 km
	Jericho I	1972	1,200 km
	Jericho II	1984-1985	1,800-4,000 km
Sea-based	Dolphin-class submarine	2000-2000	350-1,500 km —Popeye Turbo SLCM

Table 1. Israel's Tactical and Strategic Forces.[36]

Israel also has its own space-based satellite reconnaissance capability, the *Offeq* satellite, launched aboard the Shavit Space Launch Vehicle (SLV). Many believe that the first two stages of the Shavit SLV make up the *Jericho* II missile. The Shavit's capabilities are robust, and if deployed as a ballistic missile, it is capable of delivering a 775 kg payload a distance of some 4,000 km. Such a range provides the Israelis with coverage for the entire Middle East/Persian Gulf region, as well as a large part of the former Soviet Union.[37]

Israel's quest for nuclear weapons began in earnest during the 1950s. The Warsaw Pact, via Czechoslovakia, provided Egypt with a substantial arms package in 1955. Although Israel began nuclear energy research in 1948, the failure of Israel's allies in the 1956 crisis, coupled with an implicit Soviet nuclear threat,[38] convinced Israeli leaders they could not rely on others for their security. It was not until 1967, just 2 weeks before the 6-Day War, that Israel manufactured its first crude, undeliverable nuclear weapon.[39] By 1973, Israel had the capability of targeting its Arab enemies with the *Jericho* I missile and F-4 *Phantom* fighter aircraft. In fact, during the Yom Kippur War, Israel reportedly alerted its nuclear forces on two separate occasions.[40] The first alert reportedly occurred during the early phase of the war when Israeli leaders doubted whether Israel could survive the Arab attack. The second occurred soon after a report (later deemed false) of nuclear-tipped SCUD missiles being sent to Egypt.

Since these events are not publicly documented in Israel, there remains some doubt as to their exact details. Israelis familiar with

the alerts maintain they were simply to prevent their nuclear forces from being overrun by advancing Arab armies. Other officials maintain that the alerts were designed to catch the attention of either Soviet or American reconnaissance satellites, and so provide implicit warning to both the Soviet Union as well as the Arab armies, particularly Egypt's, of Israeli nuclear capabilities. Still others believe Israel demonstrated its resolve to U.S. officials in order to elicit U.S. intervention on its behalf with conventional munitions.[41] Egyptian officials acknowledge that Soviet officials warned them of Israel's alert, but emphasize it did not change their military plans.

Analysts believe that for years Israel considered the Soviet Union the biggest threat to its existence.[42] Israeli officials believed that without Soviet support, no alliance of Arab armies would dare threaten—or would be capable of threatening—to invade Israel and wipe it out. Thus, early in its nuclear history Israel wanted the capability to target the Soviet Union. By various accounts, Israel had a rudimentary capability to attack the Soviet Union by the early 1970s, though whether the capability was conventional or unconventional remains unclear.[43] When the Israeli Air Force received U.S.-made F-16s in the early 1980s, its capability for striking the southern Soviet Union with aerial refueling increased dramatically, though many doubted whether Israeli aircraft could have penetrated Soviet air defenses. By the late 1980s, with the initial testing of the *Jericho* II, Israel began to acquire increased capability to attack the Soviet Union, a threat which Soviet leaders clearly understood. The missile was not deployed operationally until 1994, however, too late for the Gulf War or for countering the Soviet threat.

Throughout this period, Israel's strategic forces were vulnerable to Soviet—later Russian—nuclear strikes. As recently as 1997, overhead imagery of the *Jericho* II missile base at Zachariah, located several miles southeast of Tel Aviv, showed that it was vulnerable to Russian and Chinese missiles, as well as to crudely-aimed, nuclear-tipped ballistic missiles by other powers. Apparently, there are no silos for the missiles on the lightly armored transporters, only shallow caves in limestone. According to analysis for *Jane's*:

> [A missile containing a] 20 kiloton warhead detonated 2,200 [meters] above and 1,000 [meters] away from its intended target within Zachariah, the surface target would still sustain severe damage from heat, radiation,

> and blast effects. 2 kilometers from ground zero, the shock . . . would be powerful enough to destroy unreinforced buildings and unprotected TELs [transport-erector-launchers], while the thermal radiation . . . would be enough to ignite combustible materials. If the base were hit with missiles having the accuracy of the M-9 [Chinese missile with a 300 meter accuracy], even reinforced underground caves would be seriously damaged by a ground burst.[44]

Close to Zachariah are a number of underground bunkers believed to house nuclear weapons for Israel's nuclear-capable Air Force units. The problem according to the report above is that because Israel's strategic assets remain vulnerable, analysts believe Israel must have adopted a doctrine of preemption, knowing full well that it had "use-it or lose-it" forces.[45] Recent improvements in its passive and active defenses, including Arrow missile defenses, may help some, but probably not enough against very long range ballistic missiles.[46]

The threats to Israel's existence have substantially changed since the beginning of its nuclear program. It seems clear that Israel's conventional superiority, backed by nuclear prowess, has stymied threats to Israel's existence from a combined Arab assault through conventional means. And after the collapse of the Soviet Union, any similar coalition would be without a superpower patron. However, Israel's predominance has not precluded what scholars call the stability/instability paradox. Though Israel enjoys stability against a major conventional threat to its existence, it does not enjoy such stability at lower levels of conflict. For example, the *intifada* has increased suicide bombing inside Israel. Despite the change in the overall threat, there has been no discernible change to Israel's nuclear posture.

No certainty may be given to Israel's nuclear doctrine. If one exists, it is known among the political elite and remains a closely held secret. Some scholars argue that the doctrine must be one of last resort (i.e., a mini-MAD) for a variety of reasons. It has been called by a number of observers the "Samson Option," based on the Biblical hero Samson who uses his strength to take out his Philistine captors. It stands in contrast to Masada, where several hundred Israelites preferred suicide to Roman conquest.[47] Some observers believe only in the "Samson Option" because it is impossible for

them to conceive that anyone could think otherwise about nuclear use.[48] Others believe it is so because nuclear forces have never been integrated into Israeli military training, or publicly into its military doctrine.[49] The problem with that view is that many Israeli military officers did their training in the United States, where U.S. forces were trained for tactical use of nuclear forces in crowded Europe.

Israel must have given some thought to nuclear use below the threshold of "existential" threats.[50] Some Israelis are concerned that under certain conditions, its threat of countervalue attacks (mini-MAD) may not be credible.[51] In addition, because Israel's nuclear arsenal is far more robust, diverse, and advanced than seems necessary for last resort alone, it is likely that Israeli leaders considered battlefield use of tactical nuclear weapons. Indeed, the only purpose for enhanced radiation warheads—if they truly exist—is for use in crowded conditions to keep collateral damage to a minimum.[52] The *Lance*, *Jericho* I, F-16, and submarine-launched nuclear forces may be configured for in-theater use against a combined-arms offensive.

Between nuclear warfighting and as weapons of last resort, there are a number of other uses for Israel's nuclear arsenal:

1. To deter a large conventional attack;
2. To deter all levels of unconventional (chemical, biological, nuclear) attacks;
3. To preempt enemy nuclear attacks;
4. To support conventional preemption against enemy nuclear assets;
5. To support conventional preemption against enemy non-nuclear (conventional, chemical, biological) assets;
6. For nuclear warfighting;
7. The "Samson Option" (last resort).[53]

It is also argued that, given Israel's spectacular 1981 raid on the Osiraq nuclear reactor in Baghdad, it actively supports a policy of conventional, if not nuclear, preemption of emerging Arab nuclear capabilities.

Others have added that Israel's nuclear arsenal may be used as leverage to keep the United States interested in Israel's survival. It was reportedly used in this way during the Yom Kippur War.[54] South African nuclear scientists and strategists believed that this

was Israel's motivation when they prepared South Africa's nuclear policy.[55] They believed that Israel's potential for massive retaliation in the Yom Kippur War provoked the United States to provide Israel with the conventional arms and diplomatic support needed to preclude Israel's destruction. Whether the Israelis purposely intended their alerts to result in U.S. intervention in the Yom Kippur War, or whether this was an unintended, but welcome, result remains unclear.

INDIA

Of all SNPs, India's nuclear policy has been the most publicly discussed. A little more than a year after India tested nuclear weapons at Pokhran, an unofficial version of a nuclear doctrine was reported. On August 17, 1999, Indian National Security Adviser Brajesh Mishra announced the Draft Report of the National Security Advisory Board on Indian Nuclear Doctrine.[56] The draft Indian nuclear doctrine called for several things:

- A minimum credible deterrent force based on adequate retaliatory capability, should deterrence fail;
- A dynamic configuration of its nuclear arsenal, based on changes in India's strategic environment, technological capabilities, and national interests;
- A design for "punitive retaliation" using nuclear weapons in the event of any nuclear attack on India;
- A nuclear force "based on a triad of aircraft, mobile land-based missiles and sea-based assets," that are to be survivable, "enhanced by a combination of multiple redundant systems, mobility, dispersion and deception;"
- A shift from peacetime deployment to fully employable nuclear forces in the shortest possible time;
- A robust and survivable command, control, communications, computing, intelligence and information (C4I2) system, with release authority in the hands of the Prime Minister or his designated successor(s);

- A no first use pledge; and
- A well-maintained and "highly effective conventional military capabilit[y]" to raise the threshold for the outbreak of conflict, whether nuclear or conventional.

The draft report was promulgated to encourage public debate over India's nuclear doctrine, but no public debate occurred. By early 2003, India announced its official "operationalized" nuclear doctrine, differing very little from the draft version. In it, India added that it would retaliate massively against any nuclear assault on its armed forces, or any chemical or biological attack against India or its armed forces.[57]

The draft nuclear doctrine was heralded by Indian officials for its remarkable display of restraint in the teeth of its nuclear-armed neighbors.[58] The doctrine's no first use (NFU) pledge indicated that India was willing to absorb a first strike before retaliating and that India's resulting nuclear posture should therefore not provoke an arms race. However, as many Indian and non-Indian scholars have noted, the draft and final doctrine are ambiguous documents. The Advisory Board that promulgated the draft doctrine held no official standing in the Indian government. Its committee members consisted of former diplomats, bureaucrats, and chiefs of the three military services. Members' ideologies reflect the whole spectrum of thinking on nuclear policy, from "disarmament doves" to "nuclear warfighting hawks."[59] It is no wonder that many people see in the doctrine what they want to see.

Few seem to agree what the doctrine means.[60] Even among scholars at India's oldest defense think tank, the Institute for Defence Studies and Analysis, there is no consensus.[61] The doctrine expressly calls for deterrence by the threat of punitive retaliation. However, one scholar argues that the doctrine reflects a strategy of deterrence by denial.[62] According to another scholar, there is a problem. Deterrence by denial is a doctrine for nuclear warfighting, a doctrine that he claims is impossible for a SNP. He argues that even deterrence based on the punishment that SNPs could inflict would be difficult to gauge against larger nuclear powers. Thus, he believes that India's nuclear doctrine is better suited for a policy of

"existential deterrence;" that is, deterrence by the threat of a small, survivable nuclear retaliatory force.[63] Yet a third scholar argues that India's nuclear doctrine only looks like it is primarily countervalue because the nuclear forces are so small.[64] One acerbic commentator, retired Rear Admiral of the Indian Navy Raja Menon, argues "in India scholars define their idea of deterrence against China and Pakistan with no scientific method and odd figures pulled out of a hat."[65]

As well, no one seems to agree on what state poses the biggest threat to India. It is not clear whether China, Pakistan, or the United States based in Diego Garcia, or some combination or all of the above, threatens Indian interests the most. For China,[66] the 1995 Report of the Indian Parliamentary Committee on Defence is clear:

> China has also continued to be the main source of major weapons, including missiles and allied technology, to Pakistan, a very hostile neighbour, causing disquiet to India. Despite warming relations with China, China is, and is likely to remain, the primary security challenge to India in the medium and long terms. Its enhancement of missile capabilities and its immense help to Pakistan in the missile programme are serious security concerns to India.[67]

Others argue that the main threat is from Pakistan, and others include the United States.[68] As recently as 1996, former Indian Prime Minister I. K. Gujral suggested the biggest threats emanated from both China and the United States:

> In the east, there is China, a full-fledged nuclear power. In the south, there is Diego Garcia, a major American naval base for its nuclear submarines as well as aircraft carriers. In the west, the Gulf region is nuclearised by the United States. Is it possible for any government in India to remain indifferent to this gigantic array of nuclear arms across its eastern, southern, and western borders?[69]

Although it may seem irrelevant to nuclear deterrence, the shape and size of the nuclear arsenal, as well as the type of delivery systems, depend largely on the nature of the principal threats. As Indian scholars have noted, SNPs may be able to deter each other with very small though survivable nuclear arsenals, but deterring a larger power, not to mention a superpower, requires far more capability.

Even so, whether SNPs can deter each other depends critically upon whether one or the other is a status quo or a revisionist power.[70]

India's doctrine is ambiguous about how large its nuclear arsenal should become. The Indian government has given no public guidance. The draft doctrine simply left it open to the dynamics of evolving threats, technology, and India's national interests. The formal doctrine says nothing. The suggested number of nuclear weapons varies considerably among analysts. Former Army Chief of Staff General Krishnaswami Sundarji argued for a relatively small nuclear force. He believed that to deter other SNPs, the arsenal should consist of about 20 warheads of 20 kilotons (KT) each; to deter larger nuclear powers (presumably China), an arsenal of 50 warheads of 20 KT each should suffice.[71] Others put the arsenal at anywhere from 100 to 400 nuclear weapons, though the precise configuration remains a mystery.[72]

The size of India's current arsenal also remains unclear. Estimates vary from the low 30s, between 60-80, to as many as 150 nuclear weapons.[73] In addition, there is little certainty about how advanced its weapons are. This problem stems from the series of nuclear tests done in May 1998. The Indian Atomic Energy Commission reported that this series of five nuclear tests involved both fission and fusion designs. On May 11, three nuclear devices were detonated simultaneously. Reportedly, one was a thermonuclear device at about 43-60 KT, another was a fission device at about 12 KT, and still another a sub-kiloton device. Two days later, two more nuclear weapons were detonated simultaneously, both low-yield, sub-kiloton devices. A number of nuclear scientists believe that the largest explosions were much smaller, as much as by a factor of four, than reported by Indian scientists. Indeed, some believe that the thermonuclear device fizzled.[74] Indian scientists reportedly answered the skeptics adequately.[75] War gamers recently estimated that in all-out countervalue exchanges, the respective arsenals of India and Pakistan may produce anywhere from hundreds of thousands to as many as 12 million deaths, with many more injured.[76] Regardless, at the time many Indians celebrated the tests as a success. Prime Minister Shri Atal Bihari Vajpayee exulted in Parliament that:

> India is now a nuclear weapon state. This is a reality that cannot be denied. It is not a conferment that we seek; nor is it a status for others to

> grant. It is an endowment to the nation by our scientists and engineers. It is India's due, the right of one-sixth of human-kind.[77]

India's weapon designs suggest a paradox. While India claims its nuclear doctrine is a minimum credible deterrence based on punitive retaliation, the tested devices suggest something quite different.[78] One Indian scholar boasted that the tests demonstrated India's ability to develop a "wide-ranging arsenal of low-yield, sub-kiloton nuclear munitions for artillery shells, boosted fission weapons, and city-busting thermonuclear weapons."[79] Sub-kiloton munitions for artillery rounds imply that Indian nuclear scientists have created battlefield nuclear weapons. Indeed, the "father" of India's nuclear program, R. Chidambaram, indicated that the sub-kiloton devices were for tactical, battlefield use.[80] Moreover, the Chairman of the Indian Atomic Energy Commission argued that Indian scientists were now capable of building enhanced radiation (neutron) warheads, though apparently there are no current plans to develop them.[81]

India's nuclear delivery systems also support the thesis that India considered nuclear warfighting capabilities to be important. An Indian foreign ministry official revealed in 2000 that India's no first use "policy does not mean India will not have a first-strike capability."[82] Analysts concede that India will not be able to field a truly effective triad for at least a decade or more. Since India's nuclear-capable aircraft and current land-based missiles lack the reach to attack targets in eastern China, India may be pursuing an Intercontinental Ballistic Missile (ICBM) capability, based on either its Surya Space Launch Vehicle (SLV) or a new design. A sea-based ballistic missile may take longer still, despite the fact that almost everyone concedes they are the most stabilizing systems.[83]

In the interim, India has several options for delivery of nuclear weapons at short ranges, sufficient to target all of Pakistan and penetrate deeply into China. India's nuclear weapons are deliverable mainly by aircraft, the *Mirage* 2000, MiG 27, and possibly the Su-30. Ballistic missiles have been produced as well for nuclear missions. Shorter range, nuclear-capable missiles include two types of the Prithvi with ranges of 150-250 km, and a potential sea-based Prithvi variant.[84] More than any other system, the Prithvi causes Pakistan to disbelieve Indian strategists when they claim that China is their main

concern. India's main intermediate missile, the *Agni*, is believed to have three variants with ranges of anywhere from 750 to 3,500 km. The first two have been tested. Whereas the *Agni* I was liquid-fueled and required at least a day or more preparation for launch, the *Agni* II is based on solid-fuel propulsion and requires only 15 minutes preparation.

The *Agni* II, with an estimated range of about 2,500 km, is intriguing. It can carry a payload of about 1,000 kg, sufficient for a nuclear warhead. In addition, Indian scientists reported greatly increased accuracy with the *Agni* II, as much as by a factor of three or more. In fact, in one test of about 2,200 km in "operational configuration," scientists claimed to have achieved an accuracy of 100 meters, and in another test, was reported to have achieved an accuracy of 40 meters.[85] Such accuracies are unnecessary for countervalue, city-busting attacks. A Circular Error Probability (CEP) of 40-100 meters is a substantial achievement. It could mean that a 12 KT warhead with a CEP of 100 meters (0.054 nautical miles) could destroy a high-value, nuclear-hardened military target with a high degree of confidence in a single shot kill probability (SSPK).[86] Were the warhead to be thermonuclear, it could take on some of the most hardened military targets in the world. A nuclear-armed *Agni* II missile would be India's preferred weapon of choice to attack military targets in a nuclear warfighting role.[87]

India's draft and formal nuclear doctrine call for robust, survivable C4I2 assets. The military controls the delivery systems, while the nuclear scientists maintain control over the nuclear warheads. Not until late 2002 or early 2003, however, did India establish a nuclear command system headed by the Prime Minister.[88] No details have been forthcoming, so it remains uncertain how the Indians maintain positive and negative controls over nuclear weapons apart from the dual control system established earlier. While some Indian strategists despair over the lack of military involvement, others believe that India will consider nuclear preemption should the military service gain operational control over nuclear weapons.[89] Ever since the 1987 Indian military exercise Brasstacks, its Army and Air Force have assumed the need to fight in a nuclear environment against Pakistan and have prepared accordingly. In one adaptation, the Indian Air Force changed its targeting plan from having to attack Pakistan's nuclear installations to attacks on Pakistan's delivery

systems so as to avoid collateral damage.[90] India and Pakistan have since signed a joint agreement to avoid attacking each other's nuclear infrastructure.[91] And because the borders are heavily populated, only military installations are targeted for nuclear missions.[92] Reportedly, there is no political or military directive to the nuclear scientists specifying the targets to be destroyed.[93]

PAKISTAN

Unlike India, Pakistan's nuclear strategy or doctrine has not been officially announced. Few political or military officials in Pakistan have discussed openly how Islamabad may consider using nuclear weapons for deterrence or in the event of a deterrence failure. One of the first public statements regarding the use of nuclear force was by Foreign Minister Abdul Sattar in late 1999:

> Minimum nuclear deterrence will remain the guiding principle of our nuclear strategy. The minimum cannot be quantified in static numbers. The Indian build-up will necessitate review and reassessment. In order to ensure the survivability and credibility of the deterrent Pakistan will have to maintain, preserve and upgrade its capability. But we shall not engage in any nuclear competition or arms race.[94]

In addition to the vaguely worded minimum nuclear deterrence, in contrast to India, Pakistan did not rule out a "first strike." It argues that because India is much larger, has greater conventional military capabilities and has a more robust economy, Pakistan must have resort to first use of nuclear weapons to preclude an Indian military victory by conventional means, let alone by nuclear means.[95] In fact, many Pakistani strategists argue that Pakistan's nuclear posture towards India is comparable to NATO's nuclear posture towards the Soviet Union during the Cold War. It must compensate for numerical conventional inferiority by relying on early resort to nuclear weapons.

A retired military officer writing in Pakistan's premier military journal provided the most comprehensive analysis of Pakistan's putative nuclear doctrine. Lieutenant General Sardar F. S. Lodi analyzed the doctrinal requirements for Pakistan in early 1999, which Indian analysts seem to accept as official Pakistani doctrine.[96] After tracing NATO's reliance on early use of nuclear weapons and briefly

analyzing the evolution of U.S. nuclear doctrine over the years, he relates how these doctrinal developments inform Pakistan's nuclear requirements:

> During any future Indo-Pak armed conflict India's numerical superiority in men and conventional arms is likely to exert pressure beyond endurance. In a deteriorating military situation when an Indian conventional attack is likely to break through our defences or has already breached the main defence line causing a major set-back to the defences, which cannot be restored by conventional means at our disposal, the government would be left with no other option except to use Nuclear Weapons to stabilize the situation. India's superiority in conventional arms and manpower would have to be offset by nuclear weapons. The political will to use nuclear weapons is essential to prevent a conventional armed conflict, which would later on escalate to nuclear war.
>
> Pakistan's Nuclear Doctrine would therefore essentially revolve around the first-strike option.[97]

The first-strike option is as important as how Pakistan may use nuclear weapons against an initial Indian attack. Lodi borrows from American strategy what is called an "option-enhancing policy" for possible use of nuclear weapons. This "option-enhancing policy" envisions a staged escalation of nuclear use in response to an Indian attack. At any point, either side may then choose to de-escalate the conflict. The stages include the following:

> Stage One: A public or private warning of nuclear use;
>
> Stage Two: A demonstration explosion of a small nuclear weapon on Pakistan's own soil;
>
> Stage Three: The use of a few nuclear weapons on its own soil against Indian attacking forces;
>
> Stage Four: Counterforce strikes "against critical but purely military targets" on Indian soil, probably "in thinly populated areas in the desert or semi-desert, causing least collateral damage"; and,
>
> Stage Five: Weapons in reserve for a countervalue attack plan.[98]

Over time, improvements would create more options and greater flexibility for Pakistan "to employ nuclear weapons if attacked yet cause the least civilian casualties and damage to infrastructure."

Commentators note that Pakistan needs a robust nuclear strategy because:

> India's earlier rhetoric of 'minimum credible (nuclear) deterrence' has been replaced by an 'effective, credible nuclear deterrence and adequate retaliatory capability should deterrence fail' [based on its change from early pronouncements to its draft nuclear doctrine], implying that a massive arsenal of nuclear weapons that would give India an offensive nuclear capability.[99]

More recently, some hint of Pakistan's nuclear doctrine was given by an active official. According to an American analyst in a Pakistani newspaper, General Khalid Kidwai, Chief of the Strategic Plans Division of Pakistan's nuclear command and control system, Pakistan's nuclear arsenal is aimed "'solely at India' and 'will be used only if the very existence of Pakistan as a state is at stake'."[100] Kidwai further enumerated the triggers for Pakistani nuclear use under a variety of circumstances:

> (a) India attacks Pakistan and conquers a large part of its territory (space threshold);
> (b) India destroys a large part either of [Pakistan's] land or air forces (military threshold);
> (c) India proceeds to the economic strangling of Pakistan (economic threshold);
> (d) India pushes Pakistan into political destabilization or creates a large scale internal subversion in Pakistan (domestic destabilization).[101]

In arguing for early use of nuclear weapons, Pakistan is posed with a problem of credibility. Though Indian analysts agree that Pakistan may gain temporary tactical advantages by early first use, they also point out that Pakistan would suffer a devastating retaliation.[102] Another retired Pakistani military officer argues that it is precisely that degree of uncertainty—even apparent "irrationality"—that lends credibility to its deterrence policy. Writing in Pakistan's premier military journal, Air Commodore Jamal Hussain argues:

> A deterrence doctrine that spells out use of first strike (nuclear) option in case enemy's conventional forces are about to achieve their strategic aim is based on a degree of irrationality . . . If the aggressor comes to the

> conclusion that it is not dealing with a mad nation, it may be tempted to disregard the nuclear deterrence of its enemy calculating that it is unlikely to unleash its nuclear arsenal, as it would in all probability end up in mutual destruction of both the contestants. Nuclear deterrence would then have failed.
>
> While commission of suicide by itself may be an act of insanity, many sane persons have committed it under what at best can be termed as temporary or momentary insanity. Mutual suicide or kamikaze acts by a human or a nation when pushed beyond a limit is in the realm of possibility. To lend credibility to its nuclear deterrence against conventional attacks by superior foes, a nation like Pakistan would like to give the impression that it would not hesitate to protect its honour, dignity, sovereignty and vital interests through mutual suicide, if all other options are closed. . . .
>
> In nuclear deterrence doctrine, everyone will be bluffing, but just how far is difficult to determine.[103]

Hussain rejects the "rational actor" assumption of nuclear deterrence, arguing instead that deterrence is largely "psychological."

The public side of Pakistan's nuclear program reflects this view. Pakistan's public policy is devised to concede nothing to Indian technological or scientific prowess, apparently fearing that to do so would portray a failure of resolve and thereby weaken deterrence. Pakistan has followed a policy of tit-for-tat.[104] For every Indian test, demonstration, or public announcement, Pakistan reciprocates with one of its own. When India explodes nuclear devices, Pakistan follows suit. When India evaluates its *Prithvi* or *Agni* ballistic missiles, Pakistan reciprocates with tests of its *Hatf* or *Ghauri* missiles. When an Indian official suggests nuclear threats, Pakistan responds with threats of its own. As one Pakistani scholar put it, "Every landmark in Pakistan's nuclear weapons program is closely linked to its troubled relationship with India and to India's nuclear aspirations."[105]

The nuclear weapons required for Pakistan's deterrence policy, because it is India-specific, are lower than India's. Whereas India may require up to 150 nuclear weapons, Pakistan may require only half of that, and maybe less. At the time of Pakistan's retaliatory nuclear weapons tests in late May 1998, Pakistani nuclear scientists

estimated that Pakistan would require 60-70 nuclear devices.[106] Current estimates of Pakistan's nuclear inventory range from 30 to as many as 50 nuclear weapons.[107] Although Pakistani officials reported detonating boosted fission, fission, and sub-kiloton nuclear weapons in May 1998, American and Indian scientists dispute the number of weapons detonated and the size of the yields. Most believe that the explosive yields were substantially less than officially reported, in some cases by an order of magnitude.[108]

Although the sub-kiloton nuclear tests suggest battlefield nuclear weapons, it is not clear how Pakistan plans to incorporate them into its nuclear doctrine. The key is how the analysts think about tactical battlefield use. According to General Kidwai's interview, "no tactical nuclear rungs are placed down in the India-Pakistan nuclear escalation ladder."[109] However, the commentator interprets this as the General not saying tactical nuclear weapons are ruled either in or out. Indeed, the doctrinal analysis by General Lodi implies tactical nuclear use at the lower rungs of the escalation ladder and General Kidwai's "triggers" for nuclear use suggest tactical nuclear weapons against Indian conventional military forces. And according to other Pakistani analysts, Pakistan "lacks spatial depth and therefore cannot afford the luxury of distinguishing between tactical and strategic, within a nuclear context."[110] On the website for the Pakistan Institute for Air Defence Studies, a page is devoted to two illustrations depicting how tactical battlefield nuclear weapons may be deployed by fighter aircraft. The "Over-the-Shoulder" method of delivery depicted allows the fighter to escape the effects of the nuclear detonation. No other commentary is attached to this depiction.[111] The following three sets of targets for nuclear missions have been suggested: "Nuclear-related targets such as missile silos, nuclear airfields, etc.; other military targets (OMT) including non-nuclear military forces, bases, installations, etc.; and, political and military command centers, economic targets and populations."[112] Some of these targets require tactical nuclear weapons.

Although Pakistan is not as technically sophisticated as India, Pakistan has a strong indigenous program for missile development. In addition, Pakistan's nuclear weapons and ballistic missile programs have been assisted by outside sources. China has helped Pakistan's nuclear weapons program, including missile development and the miniaturization of nuclear weapons.[113] North Korea has

helped Pakistan with its ballistic missile development, most notably by means of its *Nodong* missile, which is believed to be the basis for Pakistan's *Ghauri*.[114] The *Ghauri* has a range of 1,500 km (about 900 miles), giving it full coverage of almost all of India, including naval bases in the east. Pakistan's American made F-16s also contribute to its nuclear attack capability.

Unlike the other three SNPS, Pakistan's military has remained firmly in control of its nuclear program throughout its life. Indeed, the military bureaucracy has marginalized its political leadership.[115] Former Prime Minister Benazir Bhutto said that she could never get control of the nuclear decisionmaking infrastructure. Indeed, "[a]fter her dismissal as prime minister, she revealed that she had not been in charge of Pakistan's nuclear program and that during the 1990 Kashmir crisis, Pakistan had crossed the 'Red Line' without her knowledge," though she never explained what the "Red Line" was.[116] Even before India, Pakistan announced the formation of a National Command Authority (NCA), located with its Joint Strategic Headquarters, which had overall responsibility for policy, strategy, and employment of strategic forces.[117] Reports suggest that Pakistan maintains its nuclear forces in an "unconstituted state" for safety reasons.[118] That is to say, the fissionable cores of nuclear weapons are kept separate from their non-nuclear assemblies, and the warheads are unmated to their delivery systems. Some analysts suggested that because survivability of Pakistan's nuclear forces is crucial in the face of superior Indian conventional and nuclear capabilities, the NCA should predelegate nuclear release authority to military commands in the event of a decapitating strike. The predelegation of nuclear release authority has never been confirmed.[119]

CONCLUSION

After examining the literature on these four nuclear powers, it is clear that all of them have a richer view of nuclear deterrence than one might otherwise think. Indeed, according to the public announcements on nuclear doctrine, or reports on technological advancements, or testimonies from defectors and retired military officers, the idea that SNPs are limited to some form of mini-MAD deterrent seems unreasonably optimistic. The optimism rests on the notion that because MAD, even its mini-version, would be so

catastrophic that its realization is exceedingly remote, if not a virtual impossibility. The optimistic conclusion is that nuclear war may not occur. But as Table 2 demonstrates, these four SNPs consider nuclear use for a variety of pre-war and wartime uses. Of course, the benefit of talking about nuclear use in this way is that it adds to a country's strengthening of its peacetime deterrent posture.

	Pre-War Use			War-time Use			
	Covert capability	Overt capability	Threat to use/ Provoke Intervention	Demon-stration Shot	Tactical strikes	Counter-force strikes	Counter -value strikes
RSA	√		√	√			
Israel	√		√		√	√	√
Pakistan		√		√	√	√	√
India		√			√	√	√

Table 2. Nuclear Deterrence/Threat/Use Continuum.

All four SNPs have considered how to employ nuclear weapons. This is natural, given that responsible public officials must consider what may happen should deterrence fail. All have tried to avoid the "all-or-nothing" approach of total annihilation found in a mini-MAD nuclear deterrent. Unlike with tenured academics, theirs is a position of trust and great responsibility for the safety and well-being of millions of citizens. As other scholars in this volume attest, you may resign yourself to nuclear deterrence, but it is not something you strive to obtain. This will be true for SNPs, or at least for those with nuclear neighbors.

Of course, this does not mean that SNPs will necessarily engage in nuclear warfighting. It may be that although our theories of nuclear deterrence are problematic, short of "existential threats" to SNPs, nuclear restraint may continue. But policymakers and strategists should not blindly ignore the potential for wars in which nuclear weapons may be used, even when short of all-out attacks.

APPENDIX 1

CALCULATING WEAPONS EFFECTIVENESS

1. Calculating Single Shot Kill Probability (SSPK)

SSPK = $1 - 0.5^{CMP/(H/16)^{2/3}}$

Where:

CMP = Countermilitary Potential
(A measure used for calculating military utility of a weapon)

CMP = $\frac{YMT^{2/3}}{CEP^{2/3}}$

Where Y = Yield in Megatons
CEP = Circular Error Probability, in nautical miles (nm)
(CEP is a measure of accuracy of ballistic missile)

H = the hardness of a given target, expressed in pounds per square inch (psi) atmospheric overpressure (from blast)

2. Indian weapon system

Agni II, 100-meter = 0.054 nm
Warhead = 12 KT (kilotons), or .012 MT (megatons)
Notional bunker complex in Pakistan hardened to 1,000 psi.

CMP = $\frac{0.012^{2/3}}{0.054^2}$ CMP = 17.97

SSPK = $1 - 0.5^{17.97/(1000/16)^{2/3}}$

$1 - 0.5^{17.97/62.5)^{2/3}}$

$1 - 0.5^{17.97/15.75}$

$1 - 0.5^{1.140952381}$

$1 - 0.45346$

SSPK = 54.5%

ENDNOTES - CHAPTER 10

1. Michael Krepon, "Moving Away from MAD," *Survival*, Vol. 43, No. 2, Summer 2001, pp. 82-84.

2. Owen Harries, "Best-Case Thinking," *Commentary*, May 1984, p. 28.

3. See Natural Resources Defense Council, "The Consequences of Nuclear Conflict between India and Pakistan," from internet: *www.nrdc.org*, accessed February 19, 2003.

4. For a good discussion of this and related problems, see Keith B. Payne, *Deterrence in the Second Nuclear Age*, Lexington: University Press of Kentucky, 1996.

5. Jeffrey Richelson, "PD-59, NSDD-13, and the Reagan Strategic Modernization Program," in P. Edward Haley, David M. Keithly, and Jack Merritt, *Nuclear Strategy, Arms Control, and the Future*, Boulder: Westview Press, 1985, p. 123.

6. For a good discussion of theoretical approaches, see Shibley Telhami, *Power and Leadership in International Bargaining: The Path to the Camp David Accords*, New York: Columbia University Press, 1990, especially chapter 2, pp. 18-42.

7. For the most parsimonious characterization of the assumption of rationality, see Kenneth N. Waltz, "More May Be Better," in Scott D. Sagan and Kenneth N. Waltz, *The Spread of Nuclear Weapons: A Debate*, New York: W. W. Norton & Company, 1995, pp. 1-46; for the most concise critique of the assumption of rationality, see Payne, *Deterrence in the Second Nuclear Age*.

8. A good discussion of strategic personality and nuclear deterrence may be found in Caroline F. Ziemke, Philippe Loustaunau, and Amy Alrich, *Strategic Personality and the Effectiveness of Nuclear Deterrence*, project for the Defense Threat Reduction Agency, DTRA, IDA Document D-2537, Alexandria, VA: Institute for Defense Analysis, November 2000.

9. See Steve Fetter and Devin T. Hagerty, "Nuclear Deterrence and the 1990 Indo-Pakistani Crisis," Correspondence, *International Security*, Vol. 21, No. 1, Summer 1996, pp. 176-185; see also my critique of Kenneth Waltz's use of the assumption in Mark T. Clark, "Proliferation in the Second Nuclear Age," *Orbis*, Vol. 41, No. 1, Winter 1997, pp. 133-136.

10. Ukraine, Kazakstan, and Belarus inherited sizeable nuclear arsenals from the collapse of the Soviet Union and voluntarily gave them up. For a brief overview, see J. W. de Villiers, Roger Jardine, and Mitchell Reiss, "Why South Africa Gave Up the Bomb," *Foreign Affairs*, Vol. 72, No. 5, November/December 1993, pp. 98-109.

11. Indeed, the case was repeatedly cited by some officials in the George W. Bush administration as evidence why Iraq was not dismantling its weapons of mass destruction infrastructure. In the case of the RSA, the government not only helped IAEA inspectors but suggested ways the inspectors could improve their research; precisely the opposite occurred with the Iraqi regime under the constraints of Security Council Resolution 1441.

12. This section is based, in part, on Peter Liberman, "The Rise and Fall of the South African Bomb," *International Security*, Vol. 26, No. 2, Fall 2001, pp. 45-86; see also Correspondence between Helen E. Purkitt and Stephen F. Burgess with Peter Liberman in "South Africa's Nuclear Decisions," *International Security*, Vol. 27, No. 1, Summer 2002, pp. 186-194; Frank V. Pabian, "South Africa's Nuclear Weapon Program: Lessons for U.S. Nonproliferation Policy," *The Nonproliferation Review*, Fall 1995; William J. Long and Suzette R. Grillot, "Ideas, Beliefs, and Nuclear Policies: The Cases of South Africa and Ukraine," *The Nonproliferation Review*, Spring 2000, pp. 24-40. See also the presentation by the former director of the RSA's Atomic Energy Corporation, Waldo Stumpf, who headed the RSA's dismantlement effort, as "Birth and Death of the South African Nuclear Weapons Programme," on the web site of the Federation of American Scientists at *http://www.fas.org/nuke/guide/rsa/stumpf*, accessed January 15, 2003.

13. Text of statement by State Presdient F. W. de Klerk, "Matters Relating to Nuclear Nonproliferation Treaty, Violence, Negotiation and the Death Penalty," in *Debates of Parliament*, 5th Session, 9th Parliament, Vol. 8, cols 3576 to 3574, March 24, 1993, p. 3467.

14. *Ibid*., pp. 3468-3469.

15. De Klerk, testimony, pp. 3466-3472.

16. Stumpf, "Birth and Death."

17. Liberman, "Rise and Fall," p. 53.

18. *Ibid*.," pp. 55-56; and footnotes 34-36.

19. De Klerk, testimony, pp. 3468.

20. Stumpf, "Birth and Death," p. 5; Liberman, "Rise and Fall," p. 57; Long and Grillot, "Ideas, Beliefs, and Nuclear Policies," p. 28.

21. Long and Grillot, "Ideas, Beliefs, and Nuclear Policies," p. 27, 31.

22. Liberman, "Rise and Fall," p. 62; and footnote 61.

23. Mitchell Reiss, *Bridled Ambition*, Baltimore: Johns Hopkins University Press, 1995, p. 29.

24. Liberman, "Rise and Fall," p. 59; and footnote 50.

25. Warren H. Donnelly, "South Africa and Nuclear Weapons," *CRS Issue Brief*, Congressional Research Service, the Library of Congress, June 27, 1991, p. 7.

26. For an interesting insight into how the secret is kept, see Fuad Jabber, *Israel and Nuclear Weapons: Present option and future strategies*, London: Chatto & Windus for the International Institute for Strategic Studies, 1971, pp. 123-125.

27. The author calls it a culture of opacity in Avner Cohen, *Israel and the Bomb*, New York: Columbia University Press, 1998, p. 343; Robert Harkavy, "The Imperative to Survive," in Louis Rene Beres, *Security or Armageddon: Israel's Nuclear Strategy*, Lexington, MA: D. C. Heath, 1986, pp. 117-118; see also Edwin S.

Cochran, "Deliberate Ambiguity: An Analysis of Israel's Nuclear Strategy," *The Journal of Strategic Studies*, Vol. 19, No. 2, September 1996, pp. 321-339.

28. Shai Feldman, *Israeli Nuclear Deterrence: A Strategy for the 1980s*, New York: Columbia University Press, 1982); similarly, see Yair Evron, *Israel's Nulcear Dilemma*, Ithaca, NY: Cornell University Press, 1994, p. 244; Cochran, "Deliberate Ambiguity, p. 327; see also Gerald M. Steinberg, "Re-examining Israel's Security Doctrine," *RUSI International Security Review, 1999*, UK: Royal United Services Institute for Defence Analysis, pp. 215-224; from internet: *http://faculty.biu.ac.il/~steing/arms/doctrine*, accessed December 12, 2002.

29. Admittedly, even this is harder to tell since most of the literature on Israel's nuclear weapons treats the history of the program as well as the types of weapons that may have been developed, and devote little attention to actual plans for use. See, for example, Cohen, *Israel and the Bomb*; Warner D. Farr, "The Third Temple's Holy of Holies: Israel's Nuclear Weapons," *Counterproliferation Paper No. 2*, USAF Counterproliferation Center, Air War College, Maxwell Air Force Base, Alabama: Air University, September 1999, from internet: *www.fas.org/nuke/guide/israel/nuke/farr.htm*, accessed January 8, 2003; Robert E. Harkavy, *Spectre of a Middle Eastern Holocaust: The Strategic and Diplomatic Implications of the Israeli Nuclear Weapons Program*, Monograph Series in World Affairs, Denver: University of Denver Press, 1977; and Harkavy, "The Imperative to Survive," pp. 97-118.

30. Seymour M. Hersh, *The Samson Option: Israel's Nuclear Arsenal and American Foreign Policy*, New York: Random House, 1991, p. 291.

31. Peter Vincent Pry, *The Strategic Nuclear Balance. Vol. 1: And Why It Matters*, NY: Crane Russak, 1990, pp. 145-155.

32. For the expose, see "Revealed: The Secrets of Israel's Nuclear Arsenal," *The Times*, London, Issue: 8,461, October 5, 1986, pp. 1, 4-5; see also Farr, "The Third Temple's Holy of Holies." Hersh explains that the discovery of Israel's capability for constructing enhanced radiation warheads comes from weapons designers at both Los Alamos and Lawrence Livermore who studied Vanunu's photographs. See Hersh, p. 199.

33. Federation of American Scientists, Weapons of Mass Destruction, "Strategic Doctrine," from internet: *www.fas.org*, accessed December 11, 2002.

34. Seth Carus and Dov Zakheim, "North Africa/Israel," Appendix II: Unclassified Working Papers, *Report of the Commission to Assess the Ballistic Missile Threats to the United States*, Pursuant to Public Law 201, 104th Congress, July 15, 1998, from internet: *www.fas.org*, accessed April 17, 2003; see also *The Risk Report*, "Israel: How Far Can Its Missiles Fly?," Vol. 1, No. 5, June 1995, from internet: *www.wisconsinproject.org*, accessed April 11, 2003.

35. "Armaments Battle of Jericho," *Time*, August 10, 1987, from internet: *www.time.com*, accessed April 11, 2003.

36. Based on the Nuclear Resources Defense Council (NDRC) Nuclear Notebook, "Israeli nuclear forces, 2000," from internet: *www.thebulletin.org*,

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37. Federation of American Scientists, Weapons of Mass Destruction, "Jericho 2," from internet: *www.fas.org*, accessed December 11, 2002.

38. Farr, "The Third Temple's Holy of Holies."

39. Avner Cohen, "Cairo, Dimona, and the June 1967 War," *The Middle East Journal*, Vol. 50, No. 2, Spring 1996, pp. 190-210.

40. Avner Cohen, "Nuclear Arms in Crisis under Secrecy: Israel and the Lessons of the 1967 and 1973 Wars," in Peter R. Lavoy, Scott D. Sagan, and James J. Wirtz, *Planning the Unthinkable: How New Powers will Use Nuclear, Biological, and Chemical Weapons*, Ithaca: Cornell University Press, 2000, pp. 104-124.

41. Mark Gaffney, *Dimona, the Third Temple? The Story Behind the Vanunu Revelation*, Brattleboro, VT: Amana Books, 1989, pp. 144-149.

42. Hersh, *The Samson Option*; Farr, "The Third Temple's Holy of Holies."

43. Much speculation surrounds whether Israel could have used its limited air assets to attack southern cities in the Soviet Union or would have had to rely on small nuclear devices smuggled into the Soviet Union.

44. Harold Hough, "Could Israel's nuclear assets survive a pre-emptive strike?," *Jane's Intelligence Review*, January 9, 1997, from internet: *www.janes.com*, accessed April 4, 2003.

45. *Ibid*.

46. Steinberg, "Re-examining Israel's Security Doctrine."

47. Robert Harkavy, "The Imperative to Survive," p. 112; The "Samson Option" is also the title of the book by Seymour Hersh.

48. There are strong parallels with the debate over nuclear use in American and Soviet doctrine throughout the Cold War as most commentators on Israel's nuclear program are schooled in that same tradition. Without an open public debate in Israel, however, it seems presumptuous to assign a position to Israeli military and political figures with absolute certainty; it is more likely that different leaders hold different views, just as different American leaders did.

49. Steinberg, "The Future of Nuclear Weapons: Israeli Perspectives," presented at the Ninth Amaldi Conference: Security Questions at the End of the Twentieth Century, Geneva, November 21-23, 1996, from internet: *http://faculty.biu.ac.il/~steing/arms/amaldi.htm*, accessed April 4, 2003.

50. For a discussion of the different approaches taken by different Israeli leaders, see Shlomo Aronson, *The Politics and Strategy of Nuclear Weapons in the Middle East: Opacity, Theory, and Reality, 1960-1991: An Israeli Perspective*, New York: State University of New York Press, 1992, pp. 167-184.

51. Efraim Inbar and Shmuel Sandler, "Israel's Deterrence Strategy Revisited," *Security Studies*, Vol. 3, No. 2, Winter 1993/94, pp. 342-343.

52. Harold Hough, "Israel reviews its nuclear deterrent," *Jane's Intelligence Review*, November 1998, pp. 11-13.

53. See Louis Rene Beres, "Israel's Bomb in the Basement: A Revisiting of 'Deliberate Ambiguity' vs. 'Disclosure', in Efraim Harsh, ed., *Between War and Peace: Dilemmas of Israeli Security*, London: Frank Cass, 1996, pp. 113-133.

54. The earliest discussion of this possibility is found in Robert W. Tucker, "Israel and the United States: From Dependence to Nuclear Weapons?" *Commentary*, November 1975, p. 41.

55. See the discussion in the section on South Africa's development of the nuclear weapon.

56. "The Draft Report of National Security Advisory Board on Indian Nuclear Doctrine," Embassy of India, Washington, DC, from internet: *www.indianembassy.org*, accessed November 27, 2002.

57. "Indian Statement of 'Operationalisation' of Nuclear Doctrine, January 4," in *Disarmament Documentation*, The Acronym Institute, from internet: *www.acronym.org.uk*, accessed May 14, 2003.

58. George Perkovich makes the case that Indians have approached the nuclear policy problem with the conflicting goals of moral superiority through nuclear restraint and the pursuance of great power status even before the announcement of India's nuclear doctrine. The pattern continues here as well. See George Perkovich, *India's Nuclear Bomb: The Impact on Global Proliferation*, Berkeley: University of California Press, 1999, pp. 448-449.

59. Waheguru Pal Singh Sidhu, "India's Nuclear Use Doctrine," in Peter R. Lavoy, Scott D. Sagan, and James J. Wirtz, *Planning the Unthinkable: How New Powers Will Use Nuclear, Biological, and Chemical Weapons*, Ithaca: Cornell University Press, 2000, p. 127.

60. Ashley Tellis takes on this problem in Ashley J. Tellis, *India's Emerging Nuclear Posture: Between Recessed Deterrent and Ready Arsenal*, Santa Monica: RAND, 2001, pp. 296-366, though he believes strongly that India's nuclear forces are countervalue only.

61. The Institute, based in New Delhi, was established in 1965 and is funded by the Ministries of Defence and External Affairs. According to its web page, Institute scholars remains independent of the government. From internet: *www.idsa-india.org*.

62. Gurmeet Kanwal, *India's Nuclear Doctrine and Policy*, Vol. XXIV, No. 11, February 2001, Institute for Defence Studies and Analysis, New Delhi, from internet: *www.idsa-india.org*, accessed November 27, 2002.

63. Rajesh Rajagopalan, *Nuclear Strategy and Small Nuclear Forces: The Conceptual Components*, Vol. XXIII, No. 7, October 1999, Institute for Defence

Studies and Analysis, New Delhi, from internet: *www.idsa-india.org*, accessed December 9, 2002.

64. Brahma Chellaney, "India's Nuclear Planning, Force Structure, Doctrine and Arms Control Posture," *Australian Journal of International Affairs*, Vol. 53, No. 1, 1999, p. 66.

65. Raja Menon, *A Nuclear Strategy for India*, New Delhi and London: Sage Publications, 2000, p. 148.

66. P.M. Kamath, *Indian National Security Policy: Minimal Nuclear Deterrence*, Vol. XXIII, No. 8, November 1999, Institute for Defence Studies and Analysis, New Delhi, from internet: *www.idsa-india.org*, accessed December 9, 2002; see also Chellaney, "India's Nuclear Planning," p. 67.

67. Cited in Kamath, *Indian National Security Policy*.

68. Amit Gupta, "India's Draft Nuclear Doctrine," *The Round Table*, Vol. 355, 2000, p. 358.

69. Cited in Kamath, *Indian National Security Policy*.

70. Menon, *A Nuclear Strategy for India*, pp. 146-147.

71. Kamath, *Indian National Security Policy*. Arguably, Sundarji was India's greatest strategist according to Menon, *A Nuclear Strategy for India*, p. 98.

72. Gupta, "India's Draft Nuclear Doctrine," p. 355. According to the author, in the 1980s Indian analysts called for about 150 weapons; after the nuclear tests of 1998, for about 400.

73. For comparison, see "India's Nuclear Forces, 2002," NRDC Nuclear Notebook, *Bulletin of the Atomic Scientists*, Vol. 58, No. 2, March/April 2002, p. 70, from internet: *www.nci.org*, accessed January 20, 2003; see also "India's Nuclear Weapons," Weapons of Mass Destruction, Federation of American Scientists, from internet: *www.fas.org*, accessed December 11, 2002; for the higher number, see "India Establishes a Nuclear Command System," *New York Times*, January 5, 2003, from internet: *www.nytimes.com*, accessed January 6, 2003.

74. "India's Nuclear Forces, 2002," NRDC Nuclear Notebook and "India's Nuclear Weapons," Weapons of Mass Destruction.

75. Menon, *A Nuclear Strategy for India*, p. 114.

76. Paul D. Taylor, "India and Pakistan: Thinking about the Unthinkable," *Naval War College Review*, Vol. LIV, No. 3, Summer 2001, pp. 40-51; see also "12 Million Could Die at Once in an India-Pakistan Nuclear War," *New York Times*, May 27, 2002, from internet: *www.nytimes.com*, accessed January 28, 2003.

77. "Suo Motu Statement by Prime Minister Shri Atal Bihari Vajpayee in Paliament," May 27, 1998, from internet: *www.fas.org*, accessed December 11, 2002.

78. American scholar Ashley Tellis hotly contests any claims to warfighting for India's nuclear forces. See Ashely J. Tellis, *India's Emerging Nuclear Posture:*

Between Recessed Deterrent and Ready Arsenal, Santa Monica: RAND, 2001, especially Chapter Four, pp. 251-476.

79. Sidhu, "India's Nuclear Use Doctrine," p. 125.

80. Chellaney, "India's Nuclear Planning," p. 66.

81. Kamath, "Indian National Security Policy," especially note 20.

82. Cited in "India's Nuclear Forces," NRDC Nuclear Notebook.

83. Menon, *A Nuclear Strategy for India*, p. 167.

84. The CIA reportedly believes of the two land-based versions, only the *Prithvi* I has a nuclear role. See "India's Nuclear Forces," NRDC Nuclear Notebook.

85. *Ibid*.; see also Michael Kraig, "The Indian Drive towards Weaponization: the *Agni* Missile Program," report to the Federation of American Scientists, from internet: *www.fas.org*, accessed December 11, 2002.

86. Appendix I for calculations of the *Agni* II SSPK.

87. Critics are right to note that one test does not a system make. However, it remains intriguing that the Indian military that tested the system was interested in promoting its capabilities. Whether hyperbole or no, the fact remains that some officials found it important to "signal" their capability for nuclear warfighting, and we should not dismiss their claims outright.

88. "India Establishes a Nuclear Command System."

89. For military involvement see Menon, *A Nuclear Strategy for India*; for concern that military control would lead to a doctrine of preemption, see Sidhu, "India's Nuclear Use Doctrine," p. 157.

90. See the discussion in Sidhu, "India's Nuclear Use Doctrine," pp. 128-152.

91. See text of "Agreement Between Pakistan and India on the Prohibition of Attack Against Nuclear Installations and Facilities," signed December 31, 1988, from internet: *www.pnnd.org*, accessed February 19, 2003.

92. Kamath, "Indian National Security Policy."

93. Menon, *A Nuclear Strategy for India*, p. 130.

94. "Pakistan's response to the Indian Nuclear Doctrine," Foreign Minister Abdul Sattar's Inaugural Address to the Seminar organized by the Islamabad Council on World Affairs and the Institute of Strategic Studies," November 25, 1999, from internet: *http://missions.itu.int/pakistan*, Pakistan's Permanent Mission in Geneva, accessed March 5, 2003.

95. Samina Ahmed, "Pakistan's Nuclear Weapons Program: Moving Forward or Tactical Retreat?," Kroc Institute Occasional Paper #18:op:2, February 2000, Harvard University: John F. Kennedy School of Government, p. 5.

96. For Indian acceptance, see Gurmeet Kanwal, *India's Nuclear Doctrine and Policy*, Vol. XXIV, No. 11, February 2001, Institute for Defence Studies and

Analysis, New Delhi, from internet: *www.idsa-india.org*, accessed November 27, 2002.

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103. Air Commodore (Retd) Jamal Hussain, "Dynamics of Nuclear Strategy in South Asia," *Defence Journal*, October 2002, from internet: *www.defencejournal.com*, accessed December 11, 2002.

104. "Pakistan's response to the Indian Nuclear Doctrine," Foreign Minister Abdul Sattar; see also Zafar Iqbal Cheema, "Pakistan's Nuclear Use Doctrine and Command and Control," in Peter R. Lavoy, Scott D. Sagan, and James J. Wirtz, *Planning the Unthinkable: How New Powers Will Use Nuclear, Biological, and Chemical Weapons*, Ithaca: Cornell University Press, 2000, passim.

105. Ahmed, "Pakistan's Nuclear Weapons Program," p. 5.

106. Anthony H. Cordesman, "The Threat of Pakistani Nuclear Weapons," November 8, 2001, Washington, DC: Center for Strategic and International Studies, p. 6.

107. Natural Resources Defense Council, "The Consequences of Nuclear Conflict between India and Pakistan," from internet: *www.nrdc.org*, accessed February 19, 2003; Gaurav Kampani, "Safety Concerns About the Command & Control of Pakistan's Strategic Forces, Fissile Material, and Nuclear Installations," September 28, 2001, Monterey: Monterey Institute of International Studies, from internet: *http://cns.miis.edu*, accessed March 5, 2003.

108. Federation of American Scientists, "Pakistan Nuclear Weapons," from internet: *www.fas.org*, accessed December 11, 2002.

109. Jones, "Is stable nuclear deterrence feasible?"

110. Shireen M. Mazari, "Formulating a Rational Strategic Doctrine," *Pakistan Institute for Air Defence Studies*, n.d., from internet: *www.piads.com.pk*, accessed March 5, 2003.

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112. Mazari, "Formulating a Rational Strategic Doctrine." See also Natural Resources Defense Council, "The Consequences of Nuclear Conflict between India and Pakistan" for a similar list of expected targets.

113. Farzana Shaikh, "Pakistan's nuclear bomb: beyond the non-proliferation regime," *International Affairs*, Vol. 78, No. 1, January 2002, pp. 33-34; Federation of American Scientists, "Pakistan Nuclear Weapons"; and Cordesman, "The Threat of Pakistani Nuclear Weapons," pp. 3-4.

114. Federation of American Scientists, "Pakistan," from internet: *www.fas.org*, accessed December 11, 2002; Cordesman, "The Threat of Pakistani Nuclear Weapons," pp. 9-10. According to Samina Ahmed in "Pakistan's Nuclear Weapons Program," pp. 14, fn. 35, the Pakistani government has repeatedly denied that the Ghauri is based on North Korean technology.

115. Ahmed, "Pakistan's Nuclear Weapons Program," p. 6

116. Cheema, "Pakistan's Nuclear Use Doctrine," p. 163.

117. Cordesman, "The Threat of Pakistani Nuclear Weapons," p. 6. Another unverified source places the development of some kind of Command and Control much earlier. See See Cheema, "Pakistan's Nuclear Use Doctrine," p. 172.

118. Kampani, "Safety Concerns About the Command & Control of Pakistan's Strategic Forces."

119. Lodi, "Pakistan's Nuclear Doctrine."