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EMERGING POWERS, NUCLEAR-POWERED SUBMARINES AND THE NON-PROLIFERATION REGIME

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INTRODUCTION

This paper analyses the effects the acquisition of nuclear-powered submarines (SSNs) by India and Brazil is likely to have on the non-proliferation regime. Recent developments show that both states are actively trying to acquire this advanced naval system. In fact, India has already leased one such vessel from the USSR and may receive up to three more from this source.[1] Furthermore, in late 1987 Brazil announced that it was working on a nuclear propulsion system designed to give it an SSN capability. These developments raise important concerns for the non-proliferation regime which tries to stop the spread of nuclear weapons and control the dissemination of associated "sensitive" technologies. Hence the research question: how and to what extent will the acquisition of nuclear-powered submarines by emerging nuclear states affect the non-proliferation regime? The working hypothesis is that this process will have a salutary effect on it. In Section 1 the hypothetical correlation between the acquisition of nuclear-powered submarines and the non-proliferation regime is established and grounded in the theoretical literature on regimes. Section 2 examines the developments pertaining to the acquisition of SSNs by India and Brazil. In the final section some general conclusions are drawn concerning the effect acquisition of nuclear-powered submarines by emerging powers will likely have on the non-proliferation regime.

PART 1: SSNs AND THE NON-PROLIFERATION REGIME

Nuclear-powered submarines (also called nuclear attack submarines) are likely to become attractive symbols to newly emerging states, such as India and Brazil, as they move to assert themselves as primary regional and international actors. Politically, nuclear-powered submarines are seen as status symbols and as a source of persuasion. Militarily, they operate well under ice, are fast and manoeuvrable and can stay submerged for long periods. In short, SSNs are, in most respects, vastly superior to their conventional counterparts. Yet what may enhance a state's influence and capacity to survive under conditions of anarchy may not accord with the project to inculcate norms and principles about nuclear fissile material, technologies and, ultimately, weapons. It is this assertion that justifies this investigation.

Until India took delivery of the Ins Chakra only the five declared nuclear weapons states (NWS) operated SSNs: the USA, 96; the USSR, some 128; the UK, 15; France, 4; and the PRC, 3.[2] SSNs are technically not nuclear systems and do not have to carry nuclear weapons. And while most use uranium fuel enriched to about 93 percent, this is not readily configured to produce nuclear explosives.[3]

The extraction of plutonium from used reactor fuel (re-processing) is a skill that most non-nuclear states do not have; nor is the technique required to move from a 93 percent to a 97 percent level of enrichment, the estimated level for nuclear bombs. The mere possession of this complex naval capability, therefore, does not warrant the claim that proliferation may be imminent. It would be very difficult, if not impossible, for any state to obtain fuel for nuclear weapons via a submarine reactor, given its size and the characteristics of the fuel. More important, despite a

commonly held belief in the "relative autonomy" of technology, it is not a sufficient basis on which to judge a state's intentions. If this were so, there would be many more nuclear states than there are now. Fortunately, one can expect that for a state to move from the possession of the relevant technology of nuclear weapons to actual production of bombs would require serious assessment by policymakers of the political, strategic and operational environment they are in, the threats to security and goals, and the utility of nuclear weapons in responding to those challenges. This, then, is the suggested context for linking nuclear-powered submarines with horizontal proliferation. The analysis implies that the correlation between the acquisition of SSNs and the integrity of the non-proliferation regime is not a simple, straightforward one. But this begs the question, what then is the connection?

India and Brazil are not parties to the Non-Proliferation Treaty (NPT), one of the mainstays of the regime, and it is well known that neither of them holds any brief for its precepts. It is one thing for them, though, to abjure this Treaty but quite another for them to engage in activities that might imperil it. The operation of SSNs may be a strategic means to acquire and stockpile sensitive nuclear materials but avoid international criticism. As Article 14 of the NPT-related safeguards document explains, using special fissionable material (SFM) for nuclear propulsion is not an illegitimate activity. But the widespread availability and use of highly enriched uranium or plutonium would be inimical to basic regime objectives. Since it can be assumed that both India and Brazil would not allow IAEA inspection of their SSNs or shore facilities, there would be no way of ensuring that the general presumption

against nuclear proliferation was intact. This might in turn generate uncertainties harmful to the non-proliferation regime.

Another possible danger to the regime stems from the function assigned to nuclear-powered submarines, namely, attack and destruction of the adversary's submarines and surface ships. They can carry not only conventional weaponry but nuclear torpedoes, rockets and sea-launched cruise missiles equipped with nuclear payloads. It is logical to assume, therefore, that if SSNs are acquired with deterrence in mind there might be strong temptation to deploy nuclear weapons on them. Thus in their ability to accommodate nuclear weapons, SSNs can lead to the proliferation of nuclear weapons and delivery systems.

1.1 The Non-Proliferation Regime

Before analysing the nuclear-powered submarine programmes of India and Brazil and showing precisely how these will challenge the non-proliferation project, it is necessary to explain briefly what is an international regime and to show why the non-proliferation issue-area constitutes a regime. Conceptualisations of international regimes have coalesced around that offered in Stephen Krasner's edited work, International Regimes, i.e., "sets of implicit or explicit principles, norms, rules and decision-making procedures around which actors' expectations converge in a given issue-area."[4]

While several rule-guided arrangements (regimes) have been identified in international relations, most of them have been in economics. Few, if any, have been noticed in international security. The relative transparency of economic issues and their amenability to clear patterns of norms, rules and institutional procedures make it easier to organise

interests around particular issues. Robert Jervis and Charles Lipson have added that in a decentralised, self-help international environment, security issues always carry an undercurrent of conflict and instability.[5] What distinguishes security from economic issues are, therefore, the unforgiving nature of the outcomes when one actor's co-operation is not reciprocated and the uncertainties involved in monitoring others' pledges. Lipson put it incisively: "It is [the] special peril of defection, not the persistence of anarchy as such, that makes security preparations such a constant concern."[6] No wonder, therefore, that under these circumstances policymakers are predisposed to seeing security as a competitive, zero-sum game. They also often miss opportunities to co-operate.

Yet, increasingly, the rule-guided system that governs the non-proliferation enterprise is seen as constituting an "international regime" because of the stable pattern of co-operation that has evolved over the past 36 years in preventing nuclear devolution. This paper accepts the claim to a non-proliferation regime, one that also approximates a "security regime" because of the issues it purports to cover. The regime finds expression through the formal and informal norms, rules, institutions and agreements aimed at preventing the horizontal spread of nuclear weapons and associated "sensitive" technologies. To be sure, for a rule-guided system to claim regime status it must embody more than just these elements. It is the development of a stable pattern of reciprocal interactions among actors that delineates a regime from other forms of international intercourse.

The non-proliferation regime has fashioned such a stable pattern of co-operation between otherwise self-interested entities. Its overarching principle is that the spread of nuclear weapons to additional states would jeopardise international security and global welfare. A second but equally

important principle (expressed mainly through the supplier agreements of the mid-late 1970s) is that the uncontrolled dissemination of special fissionable material and technology would also undermine the objective of stopping the spread of nuclear weapons.

These guide-posts have found tangible, normative form through arrangements barring nuclear weapons from special areas of the planet, regional nuclear-free zone agreements, and a generalised Non-Proliferation Treaty (NPT). To ensure reciprocity, the International Atomic Energy Agency (1957) was charged with the responsibility of carrying out intrusive inspections of the nuclear activities and facilities of the non-nuclear weapon states (NNWS), and to report its findings to the United Nations Security Council. It is the IAEA that has sustained faith in the efficacy of the project to stem nuclear proliferation and ameliorated the prisoner's dilemma posed by nuclear weapons.[7]

The non-proliferation regime has evolved through the less formal, but equally vital, rules and decision-making procedures contained in the guidelines of the Nuclear Exporters Committee (1974), the Nuclear Supplier Group (1976) and the unilateral nuclear export policies of key suppliers like Australia, Canada and the United States.[8] Essential to the enhancement of the non-proliferation regime is the provision of information that conditions actors' incentives to go on co-operating. In addition to the invaluable technical knowledge afforded by the IAEA, provision of critical information has been made possible via the 1978-80 project called the International Nuclear Fuel Cycle Evaluation. This exercise clarified some of the controversial issues involved in the international trade in nuclear items and hence can be said to have enhanced the information base

available to adherents of the non-proliferation regime. From this, it is reasonable to conclude that there is an international nuclear non-proliferation regime--one that meets some of the broad requirements for a security regime as outlined by Jervis.[9]

Most of the world's states subscribe to the norm against nuclear proliferation chiefly because of the proven destructiveness of nuclear weapons and the threat they pose to a peaceful world order. It is this consensus that has led to their placing strong currency on achieving policy co-ordination in the nuclear area, even though the terms of such collaboration have been discriminatory and rumours of alleged defection continue unabated. In Jervis's terms, the existence of the non-proliferation regime rests mainly on the fact that war and "the individualistic pursuit of security" have come to be viewed as more costly than stable nuclear co-operation.[10]

Although the evidence supports the existence of a non-proliferation regime, its identification with the security regime construct is precisely what makes it so susceptible to technological change and state action. Lipson identified this condition as "the tendency to convert variable-sum games into constant-sum struggles" which, he adds, "is a persistent feature of security issues and an impediment to cooperative conventions."[11] The non-proliferation project may thus be deemed rational and objectively beneficial to the international community; but as rapid technological developments combine with questionable state behaviour to create the perception of uncertainty, stable, long-term co-operation may be imperiled. It is precisely this proposition that is explored in this paper.

This brief theoretical analysis suggests that, in a world where states (whether through structural constraints or deliberate policy preferences)

tend to put their own, narrow interests first, regimes may be useful in broadening their vision, on the promise that the pay-offs for mutual co-operation will be higher than that for mutual defection. It is the constant need to suffocate nuclear devolution that has ensured continuing interaction at the international level. As this co-operative enterprise has taken shape, it has served to lengthen the "shadow of the future" and made continued collaboration seem more valuable than it might be otherwise.

We have seen, however, that the uncertainties and change proffered by the international environment have meant that even the best efforts to establish and maintain co-operation sometimes breakdown. To function, regimes need certain conditions germane to the issue-area. This explains why the non-proliferation project stresses the structural conditions that give the regime its dynamism and legitimacy. Therefore, the main question in assessing the non-proliferation regime is, under what circumstances will it yield stated objectives? Conversely, what are the factors that pose a threat to its principles and norms?

Technology, combined with perceived strategic and political necessity, can be good or bad for regime efficacy. It is a central argument of this paper that any state that operates nuclear-powered submarines has access to the technology of nuclear weaponry. Having acquired SSNs, it then becomes economically and strategically sensible to have facilities for enrichment and fabrication; these would be critical for stockpiling weapons-grade material and for making nuclear weapons.[12] In means that a state could have almost the entire fuel cycle outside international safeguards, a situation that would weaken the regime through narrowing of the scope of the safeguards of the IAEA. As nuclear-powered submarines could become a

legitimate means to accumulate large amounts of SFM, without the constraints of international safeguards, then certain states might seek out similar avenues to justify holding weapons-grade material. This would erode one of the main regime principles by blurring the distinction between a "nuclear" and a "non-nuclear" weapon state.

The international safeguards system is vital to the efficacy of the non-proliferation regime. But the case can be made that the proliferation of nuclear-powered submarines will undermine it. Given the classified nature of the technology of SSNs, and the fact that as a military activity it falls outside the bounds of the IAEA, India's and Brazil's SSN programmes may undermine the Agency by obviating its continuing search for universal acceptance. In sum, the acquisition of nuclear-powered submarines by emerging nuclear states could confirm that the technical barriers to nuclear weapons proliferation are eroding steadily. This perception might in turn destroy the reciprocity that is so essential to the integrity and legitimacy of the non-proliferation regime and provide incentives for defection and subsequent decay.

2. THE CASE STUDIES

Against this hypothetical backdrop, this section examines the developments related to nuclear-powered submarines in India and Brazil. Concurrently the reactions of Pakistan and Argentina to these trends in their respective regions are examined. Since decisions affecting defence and security are based on perceived threats and opportunities, this analysis must first examine the political and security environment in which India and Brazil exist and operate.

2.1 India

The first nuclear-powered submarine to be leased from the USSR by India arrived at Visakhapatnam on 3 February 1988.[13] Public reports suggest that India will lease 2-3 more, possibly Victor-class, nuclear-powered submarines from the Soviet Union, although this is denied by Indian officials. The Ins Chakra, as the submarine has been named, is a Charlie 1-class from the early 1970s. India will lease it for 3-4 years.[14] This acquisition marks the first entry by a country other than the 5 NWS into this naval field; and the first time a nuclear-powered submarine has been acquired by one state from another.

Details of this landmark in Indian-Soviet military co-operation are still sketchy. It is thought that the submarine's crew is entirely Indian, except for the twelve advisers who were sent to assist with setting up shore facilities and carrying out manoeuvres. Indian officials say there are no Soviets on board the submarine, however, and point out that from as early as 1984 Indian navy personnel were undergoing special training at Soviet naval academies on how to handle nuclear-powered submarines. So far some 200 crew are believed to have gone to the USSR for this purpose.[15] Besides, before the vessel arrived in India, it underwent extensive exercises with other Soviet nuclear submarines in the Indian Ocean.

In its features, the Ins Chakra is capable of discharging a complement of 24 torpedoes via its 533 mm torpedo tubes. And since it is actually a missile firing nuclear-powered submarine (SSGN), it can launch both conventional missiles and cruise missiles armed with nuclear warheads. In his injunction speech, however, Prime Minister Rajiv Gandhi said the SSGN did not carry nuclear weapons and was merely intended to give the Indian Navy experience in handling nuclear power.[16]

The main reason India has decided to join the "SSN club" is that it wishes to project power in the Indian Ocean and replace the superpowers as the dominant actor there eventually. It is axiomatic that New Delhi is anxious to see the USA and the USSR disengage from the Indian Ocean, even though their presence is related more to their global competition than to any desire to threaten regional states. In the words of former Defence Minister Narasimha Rao, "India has...to be constantly aware of the great power presence in the Indian Ocean region, and the situation in the South-West Asian Region."[17] The U.S. naval build-up in the Ocean, which began in 1971 following Britain's naval withdrawal, has been a particular source of irritation to India. It has never reconciled itself to this development, mainly because of a perception that the USA's fleet favours Pakistan, a traditional rival, with whom three wars have been fought since independence. Diego Garcia, headquarters of the 1979 U.S. Central Command (CENTCOM), is a major logistics and naval base for rapid deployment of American forces if a conflict or war erupts in the Middle East or South-West Asia. Aside from being an affront to Indian pride, the base is a symbol of U.S.-Pakistani military connivance against Indian security interests.[18] Nuclear-powered submarines are meant to signify Delhi's dissatisfaction with these arrangements and its intention to restore the military balance in its favour.

A few SSGNs, of course, would hardly serve as a countervail to the forces of the USA in the Indian Ocean. But they may represent a significant political and psychological step towards occupying space that is regarded as vital to India's interests. The Navy is now capable of protracted activity in the northern Indian Ocean and the Arabian Sea; what

nuclear-powered submarines should do is extend this range to the western Indian Ocean.[19] Many Indians, feeling that the Ocean is becoming increasingly crowded with the navies of other powers, consider it critical that India shows the flag there. This ties in closely with the not uncommon view among the policymaking elite that their country has no choice but to be strong militarily, in order to fulfill its manifest mission of maintaining regional order. In this intriguing view, a weak India would imperil the security of South Asia.

India has no doubt taken into account the PRC's growing sea power. This will become increasingly worrisome for Delhi as Beijing and Moscow take steps to normalise their relations.[20] India may well have figured that it is foolhardy to continue relying on the Soviet Union to off-set the PRC's greater capabilities, naval and otherwise. The Indo-Soviet alliance may be credited largely for preventing another territorial war between the two countries.[21] In this sense, nuclear-powered submarines are an aspect of an Indian strategy to discourage any future attempt at political and military intimidation by its giant neighbour.

The sale by the USA of F-16 fighter aircraft and other sophisticated weapons to Pakistan, India's arch-rival, has not stood well with New Delhi. Neither has the fact that as a client state, Islamabad has co-operated fully with the USA in the military and logistic areas and in generally helping Washington to conduct its Southern Asian/Indian Ocean policy.[22] While is is not clear how nuclear-powered submarines would alleviate this situation, it does suggest an Indian move to pre-empt Pakistan and discourage the USA from supplying it with more advanced weaponry. Within this general context, it is important too that the PRC, another close ally of Pakistan, has sizeable forward bases on its southern front with India.

Taken together, these developments show that India's foray into the SSGN field relates intimately to a perceived combined explicit or tacit threat from the USA, China (extra-regional powers) and Pakistan.

Another issue that can be said to have influenced India's decision to acquire an SSGN capability is its legitimate concern for the security of its long, vulnerable coastline and exclusive economic zone (EEZ). The utility of nuclear-powered submarines for coastal defence is highly doubtful, but their possession would send a clear political signal to would-be aggressors about India's resolve. As regards its EEZ, much of India's oil is obtained off-shore, there are also rich fishing grounds in the 234 km zone. Clearly, therefore, economic factors must have played a role in the Indian decision.[23]

Yet, even if these "objective" security concerns were absent, India would probably still opt for nuclear-powered submarines. As Minister Rao succinctly explained:

> Our armed forces have to be strong enough to prevent or obviate any possible attempt to impinge on our ability to maintain an independent posture in World Affairs and in our National Interest.[24]

This judgement underlines India's ambition to become the pre-eminent regional power and the strongest non-aligned state. SSGNs will arguably enhance its image and prestige and give it greater political leverage over the course of regional and international events. Mr. Ghandi must have had this in mind when he observed that "All modern naval powers have acquired or are trying to acquire nuclear-powered submarines. We will not be left behind."[25]

India's nuclear submarine programme is apropos the non-proliferation regime in at least three ways. The first concerns the capabilities and

characteristics of the Charlie 1s, which are designed mainly for hunter-killer missions. Mr. Ghandi's assurance that the Ins Chakra does not carry nuclear missiles count for little when it is considered that it can accommodate eight SS-N-7 SSM anti-ship cruise missiles and a 200 kiloton yield nuclear warhead, with a range of about 64 km.[26] Since the submarine is for training purposes, there is little reason to suspect that it carries nuclear weapons. (It probably carries 500 kg high explosive conventional warheads.) But since the lease allows use of the vessel operationally, there is little to prevent India from installing cruise missiles with Indian-built warheads for use in a future war. This would be very likely if it turned out that Pakistan had in fact built nuclear weapons. If this were to happen then South Asia would become, de facto, a nuclear weapons zone.

Pakistan does not now pose a realistic threat to India's security, given the latter's demonstrable military superiority. But this may change as it becomes increasingly clear that it could produce nuclear weapons at short notice, if it has not done so yet. Pakistan plans to buy three Airborne Warning and Control Systems (AWACS) from the USA and up to 60 more F-16 Falcon aircraft. Added to the 38 it now has, they would pose a "nuisance" deterrent threat to India.[27] An Indian Air Commander said recently that Islamabad's plans to acquire AWACS could give it "a major quantum qualitative superiiority over the Indian air force, navy and army." The planes would, he added, be crucial "for a credible nuclear weapons delivery by combat aircraft."[28] A further concern for India is the disclosure that Pakistan has developed, with Chinese aid, nuclear weapons carrying medium range, surface-to-surface missiles with a span of 300 km

that could hit key Indian counter-value targets.[29] If true, Pakistan would appreciably reduce India's sub-continental strategic margin.

Pakistan's nuclear programme and force posture have, ironically, been driven by India's own impressive force build up and refusal to say if it has nuclear weapons. This policy of "purposeful ambiguity" has pushed Islamabad increasingly towards nuclear weapons. Likewise, India's SSGN acquisition strategy relates partly to Pakistan's alleged nuclear capability. Pakistan was plainly upset by the submarine procurement, which it sees as introducing a qualitatively new military equation into the region and a direct threat to regional security.[30] Furthermore, Islamabad claims this is the latest proof that India has embarked on a large naval expansion to assert its "right" to the Indian Ocean.[31]

Pakistan may do one of several things, including stepping up its nuclear weapons and missile projects, or seeking a similar arrangement with the USA. The former is more likely, as it is hard to imagine a scenario whereby the USA would consider transferring a nuclear-powered submarine to its South Asian client.[32] In a move that seems to be a partial response to the Indian SSN acquisition, Pakistan has opened talks with Canada's Submarine Services Incorporated for the supply of six hybrid/conventional nuclear submarines.[33] One can expect in the months ahead that Islamabad will take further steps in response to India's nuclear-powered submarine programme.

This leads to the second difficulty that India's SSGN present to the regime, namely the terms under which it was leased from the USSR. In other words, does it involve the transfer of nuclear propulsion technology to India and how much autonomy does India have over the nuclear reactor fuel? The record suggests that the Soviet Union will supply the fuel, retrieve it

when it is spent and also carry out periodic maintenance.[34] But if, as is expected, India acquires more SSGNs from the Soviet Union, it is hard to imagine taking them to distant Soviet bases every time they needed servicing. This would be simply too expensive. A more logical solution would be for India to establish its own shore facilities and even separate enrichment and fuel fabrication plants for its nuclear submarines. Alternatively, India could simply designate its unsafeguarded enrichment and fuel fabrication facilities as integral to its SSN programme. As any activity related to the operation of nuclear-powered submarines may be termed a military activity, and therefore secret, India could legitimately justify continuing to keep the Trombay enrichment centre free of safeguards, thereby deflecting international criticism. It could also make a case for removing all safeguards from Hyderbad (a fuel fabrication plant) and other facilities.[35] If this happened, India would have considerably greater access than it now has to SFM, including HEU and plutonium.

From the evidence, Delhi clearly hopes to develop an indigenous SSN capability. Then the argument for possessing SFM and nuclear reactor facilities outside international inspection would be a lot more compelling and, of course, legitimate. Although there would likely be some form of bilateral safeguards between India and the Soviet Union to govern the transfer of SSN technologies, Delhi may be expected to resist an agreement that would constrain and prevent it from mastering SSN know-how. If this is true, then one cannot be at all sure that Moscow would not bend its presumed strict non-proliferation rules to suit political objectives.[36]

International fears about what the India-Soviet deal may hold for non-proliferation are yet not assuaged by the widespread belief that the Soviet

Union takes a hardline approach towards the export of sensitive nuclear materials and technology. The secretiveness surrounding the deal has only made matters worse. If the Kremlin's conservatism in this area holds, then the role it is playing in helping India acquire SSNs may well be fortuitous, but if not, this may prove to be the latest instance where a NWS has helped undermine non-proliferation. Moscow's notability in the nuclear area could, paradoxically, engender a measure of nonchalance which would dampen criticism of Delhi and allay suspicion that this initial dive into the nuclear submarine waters was a means to legitimate, in international circles, its entire nuclear enterprise. Thus, both in perceptual and probability terms, the leasing arrangements could undermine the non-proliferation project.[37]

India is not party to the NPT (against which it has campaigned actively in the past) or an alternative regional agreement. It has also sizeable nuclear enrichment facilities that are not safeguarded. In light of this, there may be grounds for approaching Indo-Soviet collaboration in this venture cautiously, since it could further isolate Delhi from the regime. While it may no longer matter that India is not a member of the NPT, it is crucial that it not take measures that would effectively distance it from the broader, rule-guided co-operative arrangement by acquiring sensitive nuclear systems.

The prevailing orthodoxy is that the widespread availability and use of weapons level nuclear materials would be harmful to non-proliferation. But this is precisely the effect further acquisitions of SSGNs by Delhi will have on it. The problem would multiply if states such as Japan, South Korea, or Taiwan decided they too had good reasons to get SSNs. This may well be an instance, therefore, where example setting propels events

forward, since these states also have long coastlines and exists in sensitive environments where the tendency for the superpowers to intervene is well established. Any state which can master the technology of nuclear-powered submarines opens to itself a window to nuclear weapons. It would be hard to show, for example, that fuel acquired for submarine propulsion was not being funneled into making nuclear explosives.

India's SSGN programme may lead to what has been aptly described as a nuclear-powered submarine "proliferation chain."[38] Here, Pakistan could cite the Soviet-Indian deal as a way to convince the USA to make a similar deal with it. While the USA would not likely entertain this proposition, another close ally, the PRC, might be more amenable to a Pakistani request for nuclear propulsion technology and help in acquiring SSNs. The assistance the PRC has given Pakistan in developing nuclear-capable medium range missiles shows that it is not against sharing sensitive technologies with close allies. In both their relations with India, co-operation could lead to significant political and strategic gains.[39]

2.2 Brazil

In December 1987 Navy Minister Henrique Saboia announced that Brazil had begun a nuclear-powered submarine programme, and that construction of the first boat (likely to be an SSN) could start by the late 1990s. Preliminary research and development have been put at above US$ 38 million, but the cost of building the first of an estimated three SSNs could run as high as US$ 300 million.[40] Brazil apparently approached France and the FRG for financial and technical help but was turned down.[41] It is possible that both countries might have helped, but the negative response which greeted the announcement of the programme in Washington guaranteed that

this would not happen. It is not clear why foreign assistance was sought anyway since, according to an official of the Nuclear Energy Research Institute (IPEN), Brazil intends to make this an entirely indigenous project.[42]

Brazil's nuclear submarine project is linked directly to its growing enrichment activities, a multi-million dollar enterprise which began apace in 1979 using the gas centrifuge method.[43] President Jose Sarney confirmed this in a major speech on the country's nuclear capabilities on 4 September 1987.[44] And according to Rese Nazaré Alves, president of CNEN, Brazil is now able to enrich uranium to the 20 percent intermediate level.[45] Further, Brazilian officials disclosed in 1986 that they had enough plutonium for, among other things, nuclear submarine propulsion.[46] While this report may have been a misrepresentation, it does indicate a determined effort by Brazil to go on with its nuclear enterprise and the direction in which it is heading.[47]

Determined to master the technology of nuclear propulsion, Coordenadoria Para Projets Especiais (COPESP), the Navy's nuclear research arm, has been working closely with various university-based institutes to develop the appropriate fuel and technologies for a naval nuclear reactor. In fact, since 1979 some 400 researchers have been working on this project at the country's top universities. Also, several private companies have received contracts to build the necessary machinery and control systems. The combined effort of CNEN and IPEN, both of which receive funding from the Navy, means that Brazil should have a prototype nuclear propulsion reactor for its SSN by 1994.[48]

Brazil's enrichment programme has operated from the Centro

Experimental Aramar, a highly secured facility at Ipero, 100 km west of Sao Paulo, since 1988. Its success with enriching uranium to 20 percent shows that it has already met a key criterion for the SSN programme. Officials at COPESP, IPEN and elsewhere state that there is no plan to exceed this level of enrichment. However, experts say that the Centre has the potential to enrich uranium to 90 percent, which some estimate is sufficient for nuclear bombs. It is also important to note that Aramar is not covered by international safeguards, and that Brazilian officials have left open the possibility of using it for other military purposes.[49]

To most observers it is not clear why Brazil needs nuclear-powered submarines. It faces no apparent threat either from its neighbours or other foreign powers. Besides, it clearly has sufficient conventional naval assets to counteract any future threat to its security and vital interests from the sea.

A document published recently by the Navy tries nevertheless to place the programme to build a nuclear-powered submarine in the context of Brazil's operational and strategic requirements. At the strategic level, it argues that "Brazil must have available military power which is commensurate with its spectrum of security concerns."[50] The paper states also that Brazil must be able to defend its coastal waters against hostile navies and naval air forces. It acknowledges that this could be done just as well by surface assets, but states that SSNs are more suitable for "a distant area, along the vector axis of the threat." Aside from close and long-range defence, Brazil must, it explains, project influence in the South Atlantic by controlling critical areas. Given their stealth SSNs would afford the Navy an effective patrol capability with fewer units,

whether the threat originates in areas of vital interest (like Ascension or Cape Verde) or in the Gulf of Guinea and the general southern contour of Africa, some 4,800 km away.

The paper then describes the relative operational advantages of SSNs: greater unobtrusiveness, stealth, range, speed, and prolonged operational capability. It suggests that, compared to conventional submarines, SSNs are harder to detect because they do not need to surface for air. Second, owing to their ability to maintain high speed over prolonged periods, SSNs can reach long distances quickly and engage in long-term patrolling. Also, their inexhaustible fuel supply makes them able to sustain long operational missions. Hence the conclusion that "although conventional submarines are still useful to deny access to maritime areas, nuclear submarines are obviously more useful in distant and larger areas and for longer periods."[51]

The military imperative does not however fully explain Brazil's SSN decision. In fact, most officials connected to the project suggest that the main reason for the programme is technology. As Brazil sees it, building a nuclear-powered submarine holds out the promise of significant technological spin-offs for the civilian sector and economy. Indeed the Navy argues that if this were not so the enterprise could not be justified.[52] Thus, the Brazilian SSN programme relates integrally to the objective of having a nuclear technological base with both industrial and military content.

This still does not explain why it is necessary to build SSNs. Officials defend the project by saying that the Navy has brought its considerable expertise, discipline and organisation to bear on the nuclear

sector. This will, they argue, guarantee that the plans to exploit nuclear energy are carried out. Thus, in one sense, the SSN is the Navy's reward for undertaking this task. Due to the traditional nexus between the military and civil society in Brazil, this explanation is not surprising, although many economists will question the wisdom of using the military to spur technological development in the civilian sector. It is unlikely though that Brazil will change course, since it believes this is the most efficient way to create economies of scale in the nuclear energy area.[53]

Another factor is that, contrary to most indications, Brazil expects a shortage of fossil fuels by the close of the 1990s. This suggests that a fundamental restructuring of the Brazilian energy industry is underway, one that will see more reliance on nuclear energy in the coming years. Ironically, Brazil has only one power reactor (Angra 1), that was bought from Westinghouse in 1971, in operation. This plant has never functioned at full capacity however because of frequent breakdowns resulting from lack of new equipment. Furthermore, the other two power plants (Angra II and III) are still years away from completion and will require billions of dollars.[54] Yet, as the drive to exploit the massive resources of the Amazon grows, so apparently will Brazil's orientation towards nuclear energy, even though it has a massive, unexploited hydro-electric capacity.

To summarise, Brazil sees its naval propulsion programme as the driving force behind the development of a credible technological base on which both the military and industrial sectors can draw. As one official put it, Brazil wants the technology and the best navy at the lowest price. Further, as Brazil emerges as a power that must be reckoned with, it will be forced to broaden its strategic and political net. In this sense, a nuclear-powered submarine will be of symbolic importance. Hence the

strategy of fulfilling both a technological and military imperative with the same instrument may seem quite sensible from the Brazilian view. It allows Brazil to capitalise on the perceived strengths of the Navy and to give it a raison d'etre. In a country where the balance of power is delicate, this is no small gesture.

The prism through which Brazil's SSN programme has been viewed is consistent with its self-image and character as a potential great power, although not necesarily in the traditional sense. Nuclear-powered submarines represent a major aspect of Brasilia's long-term drive to assume a larger role in the affairs of the content and the South Atlantic region. Brazil also wants to extend its influence in the international arena. A nuclear-powered submarine capability is therefore a prudent development from its pespective: being able to construct this sophisticated naval system, now the exclusive preserve of the five nuclear powers, is bound to lend weight to its technological prowess and global status. If Brazil's SSN project succeeds, this may not only add to its power base and prestige but serve as an important symbol of its emergence.

This provides the framework for examining the implications for the non-proliferation regime of the Brazilian nuclear-powered submarine programme. Three questions appear relevant. First, what are Brazil's long-term plans for enriching and adapting uranium for submarine use? Second, how will Brazil manage the technology of nuclear propulsion in the years ahead? Third, what type of weapons systems will it choose to deploy on the SSNs?

The ultracentrifuge enrichment plant operated by Brazil is not under international safeguards, therefore it can be used for whatever purpose

Brazil wishes. In this connection, although the newly drafted Constitution prohibits acquisition of nuclear weapons, it is silent concerning the possession and stockpiling of HEU or other special fissionable material (SFM). Besides, Brazilian officials are quick to observe that nuclear propulsion technology has nothing to do with nuclear weapons. Together, these suggest that the SSN programme could become a legitimate cover for Brazil to accumulate large amounts of sensitive nuclear items.[55]

Brazilian policymakers have stated that the SSN being developed will use low-enriched uranium (LEU) fuel--about 7 percent. From this one might conclude that the project will present no problem for the non-proliferation regime. However, it bears reminding that any enrichment technology that can be used to generate LEU may also be used to produce weapons-grade HEU.[56] Scientific opinion has it that the centrifuge technique, unlike the gaseous diffusion process, is an ideal way to go from one level to the other in a short time. Moreover, its small size and lower power requirements make it useful for secret operations. Officials at IPEN counter this argument by pointing out that Brazil plans to use caramel, a fuel that cannot normally be used for nuclear explosives because of its low isotopic level. However, like all other uranium enrichment techniques, ultracentrifuges provide access to plutonium; and at any isotopic level plutonium can be used for nuclear devices. Brazil does not yet have a large scale reprocessing facility but could use any of its four research reactors to separate the plutonium from spent SSN reactor fuel.[57] Besides, IPEN has successfully tested an indigenous technique to extract plutonium in the laboratory that could show significant results in the next few years.

One plausible scenario suggests that a 50 mw nuclear propulsion

reactor, the type the Brazilian Navy is developing, could generate enough plutonium for at least two nuclear bombs each year.[58] The assumption is that a SSN operating on 7 percent enriched fuel for 600 full power days between refueling would generate 9 kg. of plutonium with a fissile capacity of 30 percent. If it were operating on 20 percent enriched fuel over twice this span, 11 kg. of the same fissile material would be produced. This plutonium could be reconfigured to give a fissile capacity of 90 percent. All told, therefore, Brazil's operation of SSNs and its breakthrough in the technology of centrifuges will enable it to accumulate significant amounts of weapons grade material at moderate cost and investment of time in the near-term.

The additional technology and expertise that Brazil will acquire from its SSN programme will undoubtedly be substantial. It is not yet clear how it will manage or dispose of this technology; but there may be reason enough for concern, as none of this technology falls under IAEA safeguards. If this is true, no one could say for sure that Brazil was not stockpiling large quantities of plutonium, obtained from its operation of nuclear-powered submarines, for weapons use. Brasilia's strong and frequent criticism of the NPT, its reluctance to enforce the Treaty of Tlatelolco and accept international controls on all its nuclear activities enlist on-going concerns about the possibility of nuclear weapons proliferation in Latin America. As one report observed,

> Any gap in a technical verification system lends itself in principle to misuse and tends to weaken the credibility of that system, particularly when [as with the NPT] that system is subject to constant international scrutiny and criticism.[59]

In short the knowledge and verification gaps that the Brazilian SSN project

will produce could become a means of added stress on the non-proliferation system.

Fortunately, it will take more than technological skill and availability of weapons-grade material for Brazil to "go nuclear." Barring questions of perception and the occasional pro-nuclear pronouncements of indiscreet generals, there is little solid evidence to suggest that Brazil is pursuing a nuclear weapons programme. The political and strategic rationale for its SSN programme does not denote specific or concrete threats that would necessitate nuclear weapons. Besides, there are no signs that relations with its neighbours, with whom there are no border disputes, or with extra-regional powers, would deteriorate to the level where nuclear weapons would be considered. Moreover, there is no credible sense in which nuclear weapons would buy Brazil more security than it has now.

As regards nuclear propulsion technology, Brazil might transfer it (and other spin-off technologies) to other developing countries, especially key ones in Latin America. This would be based both on domestic and foreign policy considerations. Concerning the former, there will be strong pressures for Brazil to join the small group of nuclear supplier states in order to bolster its foreign earnings. Regarding the latter, Brazil will certainly want to show its neighbours that its SSN programme does not threaten their security. One way to build confidence would, it seems, be to offer nuclear propulsion technology to its Latin American partners, such as Argentina and Chile.

A discussion of the possibility of Brazil transferring its nuclear propulsion technology to Argentina may be moot, since it itself is thought to be embarked on a similar project.[60] In any case, there would likely be

some strong reservation to doing so because of what this might do to UK-Brazil relations. Some Brazilian officials feel that the British would see it as an unfriendly act, in light of the unsettled Falklands/Malvinas Islands dispute. Conversely, Brazil may be less restrained as regards Chile, with which it has had normal relations for decades. As that country embraces democracy, its relations with Argentina may improve to the extent that it would be easier for Brazil to accede to a Chilean request for nuclear propulsion technology without fear of upsetting Buenos Aires. This prospect does not bode well for the non-proliferation cause. One would not necessarily expect other countries in the region to use this technology to start SSN projects of their own. However, their access to SFM, and maybe sensitive aspects of the fuel cycle, would increase greatly. It would be worse if, as suspected, there were no international safeguards in place.

It remains to be seen what attitude Brazil will take towards nuclear propulsion technology. Already it has built its first indigenous research reactor with a generating capacity of 100 watts as prelude to development of a full-scale research reactor.[61] Brazil's progress in this area, and in enriching uranium, suggests that it is on its way to accumulate considerable expertise in nuclear technology and to become an important player in the nuclear market place by the turn of the century. If true, then the next few decades promise to bring more uncertainties about the ability to maintain a non-proliferation regime.

The proposition that Brazil's SSN project may lead other Latin American states to initiate or speed up their own propulsion programmes bears some currency, especially when applied to Argentina and Chile. Argentina has a classified enrichment facility at Pilcaneyeu that the

military regime built secretly between 1978-83 and is constructing a reprocessing facility capable of separating 15 kg. of plutonium each year. Also, Argentina has more than a passing interest in nuclear-powered submarines, having reportedly approached the French for a Rubis-Class SSN following its defeat in the 1982 War. France did not oblige, obviously, but the Argentine navy has never lost interest in this system. One Latin American naval expert reported during a recent conference that Argentina had in fact begun a USD 2 billion project to develop its own nuclear-powered submarines.[62]

Despite the new spirit of co-operation that has evolved between Buenos Aires and Brasilia over the last few years, this is still in its incipient stage.[63] As the historical record points to a relationship which, until the late 1970s, was characterised more by competition than by co-operation, efforts by both countries to work closely in some areas must still be considered tentative. There seems to be, in fact, a disjuncture between the co-operative mood of the civilian governments of Argentina and Brazil on one hand and the lingering suspicion of their respective militaries on the other. This could put the nuclear confidence-building process under extreme, perhaps debilitating, stress. And it would be dealt its most serious blow if the Justicialist Party, under Peronist President Carlos Menem, should elicit a return to the extreme nationalism of a former period. It is not clear, for example, how one should read statements by Menem during the presidential campaign critical of the confidence-building measures undertaken with Brazil and hinting that Argentina did not rule out nuclear weapons in the future.[64] It is therefore not surprising to learn that Argentina has its own nuclear propulsion programme which probably predates Brazil's and may now be speeded up.

Influential Argentines, in and outside the military, believe that Brazil's foray into SSNs indicates a bid for Continental and South Atlantic dominance. But even without this added impetus, the Argentine SSN programme can be expected to continue if sovereignty over the Falklands/Malvinas remains a goal. However bewildering it may seem, many high ranking government and military officials still view force as a realistic option in recovering the Island chain.

The acquisition of SSNs by Brazil may therefore raise tensions in the region and de-rail the nascent experiment in nuclear co-operation. Even if further evidence shows that Argentina does not afterall have a SSN programme, it might nevertheless feel compelled to reconsider its abjuration of nuclear weapons and provisional support of the regional nuclear-free zone treaty (Tlatelolco). Brazil's push towards nuclear-powered submarines could therefore set in chain events that disturb the remarkably stable strategic balance that has existed among the major Latin American actors for decades. It is likely that this would impair the non-proliferation enterprise.[65]

When asked what weapons systems are likely to be deployed on its nuclear-powered submarines, the Brazilian navy lists torpedoes and, possibly, tactical missiles that will carry conventional payloads. While this may well be true, it bears reminding that the decision is still being debated and could be changed if necessary. In other words, the Navy could decide later that the strategic landscape had changed so much that it had to deploy nuclear missiles on its SSNs. It is commonly held in Brazilian military circles that it was not simply the presence of nuclear-powered submarines in the Falklands/Malvinas War that determined the outcome, but

the fact that the Argentine navy was convinced that the HMS Conqueror carried nuclear weapons. This engenders an element of skepticism: why, it might be asked, spend so much money to develop this sophisticated naval asset and then curtail its deterrent capability? It is hard to imagine that, given the lessons learned from the South Atlantic War, the Brazilian navy would rule out a nuclear cruise missile carrying option.

In this regard, one should note Brazil's rapid progress with satellite and other space technologies. By the time the first nuclear-powered submarine has been built, it is certain that Brazil will have the missile capability to launch nuclear warheads from sea. Avibras Industria Aerospacial, Brazil's foremost missile technology firm, is near completion of an anti-ship missile and is reportedly planning to develop a submarine-launched version.[66] Together these disclosures suggest that Brazil's SSN programme may be more integrally related to its satellite technology project than first appeared. It would not be far-fetched to conclude that Brazil may one day be building small nuclear warheads and sea-launched cruise missiles (SLCMs) for its SSNs.

In conclusion, the implications of the Brazilian SSN project for the non-proliferation regime has to be viewed in light of Brazil's political and strategic environment and its security calculations, however questionable some of these might be. From a purely technical outlook, the development of nuclear-powered submarines by Brazil has the potential to harm this regime. The main reason is that it will create negative perceptions and untold uncertainties, given its nuclear dimension. But even if it is assumed for argument sake that Brazil might use this as a cover for clandestine production of nuclear explosives, the international community will have ample time to find an appropriate response, in view of

the long-term nature of the project.

Brazil shows no interest now in acquiring nuclear weapons. None of its policymakers, either in the government or military, feels that there is a strategic need for such weapons--which are in any event foreclosed by the Constitution. And even if this were not so, in the debate about suitability, feasibility and acceptability, the small constituency in favour of nuclear weapons would likely lose out. A final hopeful note is that as the programme advances, Brazil may find it too expensive and capital intensive to justify it afterall. Put differently, the strategy of relying on a military project to spur economic growth may prove quite untenable. Finally, the crippling foreign debt might well be the decisive factor in whether Brazil gets SSNs or not.

3. CONCLUSION

This paper has been essentially an attempt to interpret the impact of a type of technology, nuclear propulsion, on the resilience of a set of principles, norms and collective-choice procedures for curbing nuclear proliferation. These have become institutionalised in what arguably constitutes the non-proliferation regime. States have accepted the constraints it places on their management and use of nuclear material and technology because they believe this will maximise the achievement of common goals, in the absence of centralised authority.

The regime has survived because, among other things, there is an overriding sense that the spread of nuclear weapons and unbridled disposal of fissionable material would ultimately threaten everyone's security. If this is correct, regimes do matter. They are consequential because they

lend certainty to the actions of states in specific areas. Second, they allow for intrusions that may provide vital information and lead to even further collaboration. Third, regimes can create stable, predictable relations among states by institutionalising reciprocity.[67]

India's entry into the nuclear-powered submarine arena, and the preparation by Brazil and maybe others to do so in the long-term, raises important and inevitable questions for the non-proliferation regime. The key ones are, first, will this undermine future co-operation among self-interested actors on multilateral nuclear issues? Second, will the ability to effect transparency, thereby confirming the presumption against proliferation, be impaired? And third, will the acquisition of SSNs by non-nuclear states de-rail the prospects for continued reciprocity within this regime? The empirical evidence suggests that in some key respects these questions have to be answered affirmatively; in other cases they must be qualified. The horizontal spread of nuclear-powered submarines will probably injure the regime, if they increase access to unsafeguarded highly fissionable material in many other states. Also, if they provide the justification for NNWS to have submarine-based missiles armed with nuclear warheads.

It is likely that India and Brazil have no plans to use their nuclear-powered submarine programmes as means to nuclear bombs. After all, they have the means now to produce such weapons. But given what is known about their nuclear activities and programmes, this perception will not go away and is likely to crystallise. SSNs will not ipso facto give either state more incentives to produce nuclear explosives; but they could become the foci around which their nuclear activities revolve in future. Since naval nuclear propulsion is not frowned on (because it is not a nuclear

explosion), some may exploit it to stockpile fissionable material and, if the international scene became hostile, make nuclear weapons. In terms of storing high-enriched uranium and other SFM, the pursuit of a nuclear-powered submarine programme would provide an ideally suitable justification.

Resting primarily on a political and confidence-building foundation, negative perceptions developed around the introduction or spread of nuclear-related technologies and systems will certainly be detrimental to the regime because they aggravate the problem of anarchy and the security dilemma that forever lurks in the background. As the SSN programmes of the states examined here continue to take shape, more questions relating to proliferation can be expected. Expressed differently, the arrival of nuclear-powered submarines in the military structures of emerging powers will not be a positive reinforcement of non-proliferation norms. SSNs will exacerbate the ambiguities underpinning the nuclear programmes of states like India and Brazil and add to regime decay.

At another level, the acquisition of SSNs by NNWs may not prove as harmful as first suspected. Bar enrichment and fuel fabrication facilities and the status of the fuel before entering a reactor, SSNs are not inherently suitable for generating a weapons capability. From the evidence, the reactor core of a nuclear-powered submarine is too small for such a purpose. Second, SSN fuel is not readily adapted to nuclear explosives. Third, at first glance there is little reason to suspect that the states in question, which are already capable of making nuclear explosives, would use this cumbersome route to nuclear status. And even if all the above were contrariwise, the argument would still have to take account of the

political and strategic objectives and the security imperatives of each state. It would also have to note an important but often missed observation described by Kratochwil and Ruggie as the "communicative dynamics" of regimes.[68] International regimes are highly elastic structures that often adjust without undue trauma to new technological changes and as emerging actors make their presence felt. This suggests that the effects of SSNs on the non-proliferation regime will depend largely on how other participants interpret and respond to this latest challenge from regime actors. Thus, until it is demonstrated that political, military and other factors in either nation favour linking the acquisition of SSNs with nuclear proliferation emphatically, our hypothesis must be qualified.

The claim that the acquisition of nuclear-powered submarines by India and Brazil will hurt the non-proliferation regime rests on the thesis that, where regimes are concerned, perception and uncertainty matter significantly. These factors can cause significant long-term damage to the integrity of any co-operative venture, even though the empirical evidence may not justify it. In perceptual and psychological terms, therefore, the move by certain medium-sized states to acquire nuclear-powered submarines will not be good for the regime. The values which underlie it will come under increasing stress; and a significant political burden will be placed on the criteria used to judge the regime's resilience. The cumulative effect of a range of factors that now plague the system will be to undermine further its ability to correct or induce certain patterns of behaviour. If this is true, the next few decades will prove to be an even greater challenge for the non-proliferation enterprise than past ones have been, as the nuclear-powered submarine programmes of India and Brazil,

inter alia, continue to take tangible form.

Notes

[1]Prime Minister Ghandi denies this. See Jane's Defence Weekly, 4 March 1989, p. 343. It may be, as one retired admiral of the Indian Navy said recently, that India intends to build its own nuclear submarines. Comments at MIT conference on "The Implications of the Acquisition of Nuclear-Powered Submarines by Non-Nuclear Weapon States," Cambridge, MA.: 27-28 March 1989.

[2]CRS Issue Brief, ref. IB88083 (15 February 1989), p. 4.

[3]The French design uses low enriched uranium fuel (below 20 percent).

[4]Stephen D. Krasner, "Structural Causes and Regime Consequences," in Krasner, ed., International Regimes (Ithaca: Cornell, 1983), p. 2.

[5]Robert Jervis, "Security Regimes," in Krasner, ed., pp. 173-94; Charles Lipson, "International Co-operation in Economic and Security Affairs," World Politics, vol. XXXVII, no. 1 (October 1984), pp. 1-23.

[6]Ibid., p. 14.

[7]For an imaginative, if sterile, analysis of this concept, see Robert Axlerod, The Evolution of Co-operation (New York: Basic Books, 1984); and for insightful critiques, see David E. Spiro, "The State of Cooperation: The Evolution of a Category Mistake," Journal of International Affairs, vol. 42, no. 1 (Fall 1988), pp. 205-25; and Joanne Gowa, "Anarchy, Egoism, and Third Images: The Evolution of Cooperation and International Relations," International Organization, vol. 40, no. 1 (Winter 1986), pp. 167-86.

[8]For an analysis of these and other aspects of the regime, see the author's forthcoming article in Journal of Peace Research, entitled "Regime Building in the Non-Proliferation System.

[9]Jervis, "Security Regime," passim.

[10]For a good treatment of this point, see Roger K. Smith, "Explaining the Non-Proliferation Regime: Anomalies for International Relations Theory," International Organization, vol. 41, no. 2 (Spring 1987), pp. 253-81.

[11]Lipson, "International Cooperation," p. 15.

[12]According to the NPT, only states possessing nuclear weapons on 1 January 1967 may have unsafeguarded enriched uranium. Others may do so only under Article 14.

[13]International Defense Review, vol. 21, no. 5 (1988), p. 585.

[14]Some reports say 3, others 4. See Ibid.; Gregory R. Copely, "India: A New Great Power Arrives," Defense and Foreign Affairs (Dec. 1988), p. 12.

[15]International Defence Review, vol. 21, no. 2 (1988), p. 108.

[16]Jane's Defence Weekly, 5 March 1988, pp. 386-87.

[17]Interview with Gowrishankar Sundaram and Mike Howarth, International Defence Review, vol. 2, no. 4 (1988), p. 431.

[18]Current News, 19 April 1989, p. 16.

[19]I am grateful to Selig Harrison of the Carnegie Endowment for International Peace for this and other insights. Interview in Washington, D.C., 21 February 1989.

[20]For details of this process, see "Russia's Search for a Treaty with China," Manchester Guardian Weekly (4 Sept. 1988): pp. 13-14; and "Reaping the Fruits of Realpolitik," The Christian Science Monitor (28 Nov. - 4 Dec. 1988), p. 28.

[21]India claims 14,500 square miles of land held by the PRC in the Aksai Chin area, while China claims 34,000 square miles of Arunachal Pradesh state. See "Warily Towards Their Himalayan Pass," The Economist, 24 December 1988, p. 43.

[22]This was corroborated in conversation with the Indian High Commissioner to Canada. Personal Interview in Ottawa, July 1989.

[23]Note, for example, Mr. Ghandi's comments in Facts on File.

[24]IDR interview, p. 31.

[25]Jane's, 5 March 1988, p. 5.

[26]IDR, vol. 21, no. 5 (1988), p. 588.

[27]See Defence (May 1989), p. 303.

[28]Facts on File, vol. 38, no. 2479, p. 390.

[29]Defense News, 14 November 1988, pp. 43-44.

[30]Nucleonics Week, 21 January 1988, p. 12.

[31]Conversation with the Pakistani Naval Attaché to Washington, 23 February 1989.

[32]This was also the view of the Attaché, although one report said Pakistan had discussed that very possibility with the American Ambassador in Islamabad.

[33]Jane's, 30 January 1988, p. 152.

[34]Jane's, 9 January 1988, p. 11.

[35]For a complete status of India's nuclear facilities, see Leonard Spector, The Undeclared Bomb (Cambridge: MA.: Ballinger for The Carnegie Endowment for International Peace 1988), pp. 111-15.

[36]One participant in the MIT conference held that Moscow agreed to give India SSN in 1984 to placate it for its intervention in Afghanistan. But the agreement may go as far back as 1981 when the current Indian President was Minister of Defence. See International Defence Review, vol. 21, no. 2, 1988, p. 108.

[37]Testifying before the subcommittee of the House Committee on Foreign Affairs, 12 February 1988, Deputy Under-Secretary of State Robert Peck said of the Soviet SSGN lease to India: "Encouraging India, which has been a leading opponent of the NPT, in the military uses of nuclear energy, and provision of closely-held naval reactor technology to that country would, in our view, undermine the international non-proliferation regime." Quoted in "India and Nuclear Weapons," CRS Issue Brief, reference 1B86125 (Washington, D.C.: Library of Congress, 27 January 1989), p. 11.

[38]Term borrowed from Ben Sanders and John Simpson. See their "Nuclear Submarines and Non-Proliferation: Cause for Concern," Occasional Paper No. 2 (Southampton: Centre for International Policy Studies, July 1988), p. 5. See also George H. Quester, "Introduction: In Defense of some Optimism," in Quester, ed. Nuclear Proliferation: Breaking the Chain (Madison: University of Wisconsin Press, 1981), pp. 1-14.

[39]For a good analysis of the present state of Indo-Chinese relations, see Surjit Mansingh & Steven I. Levine, "China and India: Moving Beyond Confrontation," Problems of Communism, vol. XXXVIII, no. 2-3 (March-June 1989), pp. 30-49.

[40]As at December 1987 "Brazil Planning Nuclear Submarine Fleet," Jane's, 19 December 1987, p. 1445.

[41]Official at the Brazilian embassy in Ottawa in conversation with the writer, 27 January 1989.

[42]IPEN, based at Sao Paulo University, is a key participant in the Navy's nuclear reactor facility at Ipero. A former top Brazilian navy official told this writer that the UK offered Brazil SSNs in the late 1960s but that it turned down the offer.

[43]See "Brazil Faces the Fallout," South (April 1989), pp. 73-74.

[44]Brazil's achieved its first enrichment success in 1982, according to the director of COPESP. Interview in Sao Paulo, 12 June 1989.

[45]Keesing's International Archives, vol. XXXIV (September 1987), p. 35822.

[46]"Brazil Says it now Produces Small Amounts of Plutonium," The Washington Post, 18 December 1986, p. A58.

[47]See "Brazil Denies Report of Reprocessing, Plutonium Production at IPEN," Nuclear Fuel, 29 December 1986, p. 9.

[48]Manchete, 27 May 1989, p. 30.

[49]The 1975 nuclear research agreement with the FRG was carefully crafted to avoid international safeguards.

[50]"The Nuclear Powered Submarine: What is its Justification? How Do We Achieve One? What Does the Navy Intend To Do With It and To What End?" (Brazilia: Navy Ministry, May 1988), p. 8.

[51]Ibid., p. 6.

[52]This argument was heard repeatedly in conversation with top Navy officials. Interviews in Rio de Janeiro and Brasilia (June 1989).

[53]The military has been traditionally involved in the nation's productive sectors, such as the building of dams and the development of a modern telecommunications system and aviation industry.

[54]For full details, see "Brazil Faces Fallout."

[55]As the navy put it, "Nuclear propulsion...is not a weapon; it is a type of propulsion that has certain features that make it better than conventional power, (i.e. mobility, autonomy and the fact that it does not require air from the surface)." Ibid., p. 14.

[56]This can be accomplished in 3 ways using the gas centrifuge method: batch recycle, parallel overlap and modified cascade.

[57]Research reactors use the same basic technology as production reactors, which Brazil does not have but could develop in a short time. The production reactor is capable of producing large amounts of plutonium. Like research reactors, they are relatively cheap, require a minimum of technology and are easily refueled. See Nuclear Weapons Proliferation, vol. II (Washington, D.C.: Atlantic Council of the United States, 1978), p. 17.

[58]The minimum critical mass of plutonium required for nuclear weapons is 4 kg. of metal or 6 kg. of oxide (Ibid., p. 10).

[59]Sanders & Simpson, "Cause for Concern," p. 8.

[60]Some Argentine officials are tight-lipped about this, but the sub-chief of strategy in the Ministry of Defence confirmed that there was a project to develop SSNs. Brazilian Navy officials are also convinced of this. (Private interviews in Sao Paulo and Buenos Aires, June 1989.)

[61]Journal of Defense and Technology, p. 56.

[62]Address by Adrian J. English, MIT Conference on SSN programmes in

NNWS (27-28 June 1989). However, no independent confirmation is available.

[63]See "A-Bomb Spread in Secret," The Christian Science Monitor, 28 Nov. - 4 Dec. 1988, p. 3.

[64]See Leonard Spector, "Nonproliferation - After the Bomb has Spread," Arms Control Today, vol. 18, no. 10 (December 1988) p. 11.

[65]There is some suggestion that Brazil might team up with Argentina on the SSN project. Among the precedents cited are the joint fast-breeder reactor project and the annual naval exercises that both states have engaged in since 1978, as part of the "plans for cooperation and exchange between [their] two navies." FBIS, Daily Report: Latin America, 15 Feb. 1989, p. 24. Curiously, officials in the Washington embassies of both countries do not seem to rule out this possibility, although this may be just wishful thinking. The nuclear confidence-building measures have seen officials on both sides visit each other's facilities but have not involved monitoring the quantities and enrichment levels of uranium processed, or accounting for its disposition. Nor has it meant the sharing of prized nuclear know-how. Besides sources close to the SSN project have stated categorically that Brazil would not co-operate with any state to develop SSNs. Clearly, Brazil wants this to be a "national crown jewel."

[66]Jane's Defence Weekly, 5 March 1988, p. 401.

[67]For an elucidation of this concept, see Robert O. Keohane, "Reciprocity in International Relations," International Organization, vol. 38, no. 1 (Winter 1986), pp. 1-27.

[68]Friedrich Kratochwil and John Gerard Ruggie, International Organization, vol. 40, no. 4 (Autumn 1986), esp. pp. 766-71.