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The Military Nuclear Program in Brazil

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I: Introduction[1]

Toward the Proliferation Threshold

Since Brazil and West Germany surprised the world by announcing that they had reached the nuclear "deal of the century" in 1975, many national and international observers have feared that Brazil sought to develop atomic weapons. Brazilian rejection of the Nuclear Non-Proliferation and Tlatelolco treaties, insistence on its legal right to develop so-called peaceful nuclear explosives (PNEs), aspirations to great power status, authoritarian military government, and tacit nuclear rivalry with Argentina aroused concern that this ambitious program of reactor construction and technology transfer would mask an effort to reach the bomb.

Although difficult financial circumstances derailed this program in the late 1970s, by the early 1980s press reports began to emerge indicating that a secretive "parallel" nuclear program under military direction was underway. Transition to democratic rule in 1985 failed to clarify the nature and objectives of this second effort, and provocative statements by

[1] I would like to thank Jonathan Benjamin-Alvarado, George Bunn, Jim Doyle, David Holloway, Leigh Payne, David Rossin, Dean Wilkening, and especially Itty Abraham for their helpful criticism of previous drafts of this work. My field research was funded by the Program on Peace and International Security of the Social Science Research Council and the MacArthur Foundation, and the Institute for the Study of World Politics, and conducted in affiliation with the Núcleo de Estudos Estratégicos, Universidade Estadual de Campinas, and the Instituto de Relações Internacionais, Pontífica Universidade Católica, Rio de Janeiro. I would also like to thank the Center for International Security and Arms Control at Stanford University, and the Global Studies Research Program and the Graduate School of the University of Wisconsin-Madison, for their financial and intellectual support.

senior military officers intensified concerns. This second nuclear program was never acknowledged by the Brazilian government until its 1987 announcement that researchers had succeeded in enriching uranium, the crucial technological step toward production of atomic weapons. Investigative journalism brought disturbing revelations of a deep shaft in an Air Force base in the Amazon jungle that might be used to test an atomic explosive, and of secret bank accounts that clandestinely transferred federal monies to the parallel effort to skirt legislative accounting. This second effort persevered in the face of the severe economic conditions that made the 1980s a "lost decade" for Latin American countries, increasing international stress on nonproliferation, and protests from domestic anti-nuclear and environmental groups, as well as a 1990 investigation by the national congress.

By 1991, however, Brazil had formally renounced PNEs, agreed to establish bilateral safeguards with Argentina and to accept International Atomic Energy Agency (IAEA) inspection of formerly secret nuclear facilities, and committed to ratifying the Treaty of Tlatelolco. This marked the apparent reversal of a long trajectory toward the proliferation threshold, and thus assuaged apprehension within and outside the country. Yet military involvement in nuclear technological development continued essentially unaltered, and Brazil now enjoys the distinction of being one of the few states with the indigenous capacity to produce fissile material necessary to construct atomic weapons.

This paper seeks to answer two questions: *Given limited resources and domestic and foreign opposition, how did the Brazilian military succeed in developing this capacity? Given their determined effort and enduring role in nuclear development, why did the armed forces stop short of the bomb?*

The predominant tendency in studying proliferation is to assume that international factors, especially external threats to state security, drive efforts to reach the nuclear threshold. Most analyses likewise emphasize international disincentives, such as those imposed by the international nuclear nonproliferation regime, in dissuading states from developing atomic weapons. It is common, moreover, to presume that values and ideas are merely derivative of actors' material and political interests, and that the normative content of policymakers' public declarations is of merely rhetorical consequence.

This study, by contrast, demonstrates how domestic political processes and interpretations are manifest in state behaviors bearing on proliferation. International variables shaped the Brazilian experience, but their influence was less important than domestic political struggles. Furthermore, ideas about nuclear affairs held by Brazilian actors do not correspond directly to the understandings orienting most scholars of proliferation. Grasping these "indigenous" interpretations is essential to explaining the outcome of this nuclear experience.[2] This study explains both Brazilian determination to master the nuclear fuel cycle, and forbearance in yielding the nuclear option, through analysis of domestic ideas and politics.

Preview

This study answers these two questions through investigation of domestic political processes, which involve the formation and maintenance of programmatic coalitions that marshal human, material, and political resources for technological development. Such

[2] In being partial and reflecting particular interests and experiences, these interpretations are neither more nor less "provincial" than those evident in security studies produced in the United States.

coalitions encounter constraints which include competition for scarce human and financial capital, international technological denial, and domestic and international opposition. Such programs must be either effectively insulated from domestic challenges, or politically defended and normatively legitimated in spite of them.

The following section of this study details the origins and evolution of the "parallel" nuclear program in Brazil, and identifies factors that enabled it to overcome numerous obstacles. It emphasizes perceived failures of the 1975 accord with West Germany as prompting the parallel effort, and the central role of the Brazilian Navy in selecting and developing a viable enrichment technology. In addition to this bureaucratic champion, the program benefitted from minimal internal competition for resources and limited inter-service rivalry, as well as from programmatic, managerial, and budgetary continuity.

The third section details the motivations of actors that coalesced around this effort. The success of the parallel program in achieving indigenous mastery of uranium enrichment reflected the convergence of partially contradictory objectives of a number of bureaucratic actors. Their coalescence was made possible by the *multivocality*[3] of dual-use technology, the compartmentalization of information regarding diverse projects, and the inclusive vision of technological autonomy. For the armed forces, the program served to manifest perceived competition with Argentina, as well as to enhance Brazil's prestige abroad and win societal respect for the military at home. For its dedicated and capable organizational proponent, the Brazilian Navy, it provided a means to develop nuclear submarine propulsion. For small groups in the Air Force and intelligence services, the program furthered ambitions to construct atomic explosives. Unaware of these ambitions, and in addition to offering employment and cutting-edge research, civilian technicians understood the effort to be in the patriotic service of national technological and energy autonomy. In fact, the entire heterogeneous coalition was united by the vision of technological autonomy universally shared among its participants.

The fourth section examines how the international nuclear nonproliferation regime and societal contestation of military control led toward greater transparency and renunciation of the bomb, but failed to dislodge the armed forces from nuclear development. Beyond limiting access to sensitive technologies, the international regime imposes a normative and political burden of proof that nuclear programs in the developing world not be directed toward development of atomic weapons. The impact of such regimes, however, depends primarily upon the extent to which their ideas and values serve or are congruent with the interests and principles of influential domestic actors. Secrecy and authoritarian decision-making permitted insulation of the program for several years, but transition to democratic rule in 1985, the enrichment announcement in 1987, and the rising salience of nonproliferation on the international security agenda in the 1990s made it necessary to defend the program against increasing domestic and international opposition. While secrecy initially sheltered the program, it also bred mistrust and suspicion as nuclear affairs became an arena of societal contestation of military autonomy in Brazil. The armed forces succeeded in maintaining their role in nuclear development by emphasizing the sharp contrast between their own technical accomplishments and the costly failure of the official program, increasing public and legislative access to information regarding nuclear projects, relinquishing the

[3] Multivocality characterizes social behavior when different actors understand the same actions in very different ways. It is of causal significance when "single actions can be interpreted coherently from multiple perspectives simultaneously,...single actions can be moves in many games at once, and...public and private motivations cannot be parsed" (Padgett and Ansell 1993:1263). Although their study is of a very different phenomenon, it likewise underscores the importance of ambiguity in nurturing a heterogenous and contradictory coalition.

legal possibility of developing atomic weapons, and exploiting the idea of technological autonomy to legitimate their involvement.

The fifth section reviews the findings of this examination of Brazilian nuclear development. It underscores the causal significance of the idea of technological autonomy in creating military and governmental consensus in favor of the parallel effort, in eliciting civilian participation in the coalition that carried it to fruition, and in legitimating the program before skeptical domestic audiences. It concludes by noting insights gleaned through this study that may inform the theoretical understanding of proliferation.

II: Origins and Progression

Product of Failure

Although both pursued technological development, the official and "parallel" programs pursued quite different paths toward this goal. While the former was highly dependent on West German cooperation, the latter relied on indigenous Brazilian efforts. The official program's exclusion of key domestic sectors, dubious technical and economic foundations, and failure to gain access to a proven enrichment technology provoked strong opposition from civilian sectors and catalyzed an alternative effort by the armed forces.

Announcement of the 1975 accord between the West German firm Kraftwerk Union (KWU) and the Brazilian state nuclear firm Nuclebrás came as great a surprise to most in Brazil as it was abroad. Only a very restricted circle of officials in Itamaraty (the foreign ministry), the Ministry of Mines and Energy, Nuclebrás, and the Presidency were involved in decision making, and negotiations were not revealed until the accord was concluded. Government mistrust and the official program's focus on reactor construction entailed the professional exclusion of Brazilian physicists and other scientists, both in negotiation and implementation of the accord. The military services were likewise excluded and remained uncommitted, while the National Nuclear Energy Commission (CNEN-Comissão Nacional de Energia Nuclear) was supplanted by Nuclebrás. The Brazilian negotiating effort reflected the ambitions of Itamaraty to secure an accord and thereby bolster Brazil's international profile (Britto de Castro et al. 1989:23; Solingen 1990:139; Solingen 1987:115).

The 1975 accord had five elements: uranium exploration and mining, uranium enrichment via Becker jet nozzle technology, fuel fabrication, spent fuel reprocessing, and nuclear power plant construction (Myers 1984:886). The Geisel administration sought through the accord to address what later proved to be very unrealistic estimates of growing energy demand, to achieve autonomy in a leading technological sector, and to enhance Brazil's international and regional standing. While production of atomic weapons may have been one objective sought through the agreement, it was clearly not the only or primary goal.[4]

While the accord emphasized reactor construction for energy generation, the Geisel administration also sought technological mastery of the entire nuclear fuel cycle. Uranium

[4] As a U.S. military analyst of regional security affairs wrote in 1984, "If Brazil's primary purpose for creating a nuclear power production capability were simply to develop a military nuclear device, a far less complex and much less expensive program would probably have already achieved that goal." (Manwaring 1984:44).

enrichment is key to this cycle, and the government initially sought ultracentrifuge enrichment technology as part of the accord. When U.S. pressure and Dutch anti-nuclear activism led Holland to veto transfer of this technology,[5] Brazilian negotiators settled for a German commitment to joint development of the unproven jet nozzle method. The Geisel government, however, emphasized technology transfer in justifying the accord before national audiences.[6]

The Brazilian scientific community expressed vociferous and unified opposition to the official program, due both to its exclusion and scientists' evaluation of the program as unduly ambitious, anti-democratic, and as cloaking military objectives (Leite 1995; Solingen 1987:126, 390, 402-12). Opposition was compounded by press revelations that KWU would maintain close financial and managerial control over its Brazilian counterpart Nuclebrás, and that the first power reactor was sited over one of the few earthquake fault lines in Brazil (Füllgraf 1988:90-91). Focus on energy generation in the official program was criticized, moreover, as based on unrealistic and possibly deliberately misleading estimates of Brazilian energy needs and potential hydroelectric resources. The official program consequently met sharp opposition among diverse scientific, industrial, media, and political sectors. Although subjected to a slanderous intimidation campaign by the intelligence services, these groups nevertheless succeeded in prompting a very critical and high-profile Senate inquiry in 1978 (Pinguelli Rosa et al 1991:47-55; Lima 1986:223-4). Moreover, an alliance of liberal economic policymakers and pro-hydroelectric interests emerged in the late 1970s to undercut Nuclebrás and the official program (Nazaré 1995a; Solingen 1990:140). Critics charged that the government had either "sold out" to foreign interests, or had been simply ingenuous in expecting transfer of technologies that would enable Brazil to escape dependence on foreign sources (e.g., Francisco de Carvalho et al 1987:90-91).

Likewise frustrated by perceived West German unwillingness to transfer nuclear technology, dubious that the jet nozzle would prove effective, and determined to realize technological autonomy, Brazilian military officers proposed an alternative effort that won support from government leaders and civilian technicians who objected to the dependence of the official program on foreign suppliers and expertise. Military officers involved in the "parallel" effort concluded that Nuclebrás had accepted an unpromising enrichment technology to secure agency jobs and thereby "betrayed" their mandate to negotiate access to such technology. They viewed the Geisel administration as naive in expecting that West Germany would in practice transfer sensitive technology (Pinheiro da Silva 1995; Pinheiro da Silva in *Diário do Congreso Nacional* [hereafter cited as *Diário*] 1990:5717).

In sum, the official program established by the Brazilian-West German accord reflected a narrow bureaucratic and policy coalition, which proved unable to overcome criticism and resource constraints. An alternative, which coupled military and civilian objectives in pursuit of an indigenous path to technological autonomy, emerged in response to the perceived failures of the official effort.

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[5] On anti-nuclear activism in Holland, see Girotti 1984:101-2. Brazilian efforts to gain access to enrichment technology date to the 1950s, and were long stymied by U.S. intervention. Brazilian specialists still recall U.S. interdiction in 1954 at Antwerp and other European ports, which prevented the transfer of three primitive German centrifuges to Brazil (Archer 1994; Silva 1991:11; *Veja* 9/9/87: 24-5. See also Gall 1976:181-2). U.S. pressure to block transfer of ultracentrifuge technology in the mid-1970s was viewed across the political spectrum in Brazil as commercially motivated; as an effort to maintain monopoly control on the lucrative nuclear export market (Lima 1986:188-9).

[6] For example, a book approved by the government and published by the Army publishing house to expound the merits of the official effort boasted that "Technology transfer—the keystone of the Brazil-Germany Accord—is a process that involves personal relations between the possessor and receiver of know-how. This is not a matter of buying plants and specifications. Those are the fish of the parable. To transfer technology is to teach how to fish." (Biasi 1979:126-7).

Mastering Enrichment Technology

The Brazilian Autonomous Program of Nuclear Technology (PATN-Programa Autônomo de Tecnologia Nuclear), or parallel program, was established in the late 1970s in a context of increasing military and governmental disillusionment with the official program of nuclear energy development in cooperation with West Germany. The decision to initiate the effort was made by President Figueiredo, on the recommendation of his military advisors and military ministers. Technical units within the three armed forces directed projects with the participation of civilian researchers, who were likewise dissatisfied with the perceived failure of the official effort to further national technological autonomy. Financial resources were provided by the military services, the National Security Council (CSN-Conselho de Segurança Nacional), and the National Nuclear Energy Commission (CNEN-Comissão Nacional de Energia Nuclear). The effort was coordinated by the CNEN under the direction of the CSN.

The PATN focused on technological processes to master the nuclear fuel cycle, notably the enrichment of uranium, thereby permitting utilization of Brazil's abundant natural uranium reserves. Each of the three services pursued a different avenue toward acquisition of enriched fissile material. After initial investigation of laser enrichment in conjunction with the Air Force, the Navy selected ultracentrifuge technology as the most promising approach. Air Force researchers continued with the theoretically attractive but industrially untenable laser effort. Army specialists sought to develop a graphite reactor that would have produced plutonium. Both the Navy and Air Force efforts were oriented toward specific military applications that fit within traditional mission orientations; the Navy sought to ensure a reliable source of fuel for nuclear-propelled submarines, while the Air Force aimed to develop a useful power supply for satellites.

According to official Brazilian sources, the Navy project realized notable success in the course of a few years of work. While funding was quite limited and serious efforts began only in February of 1980, Pinheiro da Silva's team at the Institute of Technological Research (IPEN-Instituto de Pesquisas Energéticas e Nucleares) constructed its first centrifuge in December 1981. Although researchers lacked computers to facilitate calculations, development proceeded and the first isotopic enrichment experiment was conducted in September 1982. A mini-cascade of nine centrifuge machines was put into operation in September 1984. Announcement that Brazil had mastered the enrichment process—which took place sometime in 1986—was delayed, however, until September 1987, by which time the ultracentrifuges had been functioning for thousands of work hours (Fonseca in *Diário* 1990:5706; GT/Pronen 1990:39; Pinheiro da Silva 1995; Cavagnari 1993:16; *JdT* 9/9/87; Pinguelli Rosa et al 1991:93-94).

This delay was motivated in part to avoid creating unrealistic expectations. PATN officials feared that if laboratory success were heralded but then followed by failure to successfully sustain industrial capacity production, they would suffer sharp criticism (Nazaré 1995c). Delay was also motivated more specifically by the need to wait until critical machinery had arrived in Brazil from West Germany, which would ensure that regardless of international reaction to the announcement, the Navy would be able to produce its own advanced ultracentrifuges. PATN officials anticipated further restrictions on nuclear "trigger list" items following the announcement, and Pinheiro da Silva requested that the announcement be delayed as long as possible. Navy efforts were lent urgency by Argentine President Alfonsín's invitation to his Brazilian counterpart Sarney to visit the Pilcaniyeu enrichment facility, as they realized that acceptance would require a reciprocal gesture that

would reveal the emerging Brazilian enrichment capacity (Pinheiro da Silva 1995). By the time of the announcement, however, Brazil had acquired the machinery necessary to permit manufacture of ultracentrifuges (Pinheiro da Silva 1995; Saboia 1995; *GM* 9/8/87; Nazaré 1995c).

By September 1987, the IPEN laboratory-scale facilities using six centrifuges had reportedly produced several kilograms of uranium-235 enriched to 1.2%. CNEN President Nazaré assured that Brazil would not exceed 20%, a level generally considered inappropriate for use in atomic weapons (*OEdSP* 9/6/87; *FdSP* 9/6/87; Spector with Smith 1990:247, 250). The Aramar industrial-scale plant reportedly produced material at the 5% enrichment level at its inauguration in 1988 (Albright 1989:19-20), and officials have subsequently reassured that enrichment will not exceed the 20% level. Fuel enriched to this grade is to be employed in a small reactor under development for use in submarine propulsion.

The number of centrifuges currently operating at Aramar, their internal design, and their combined enrichment potential remain closely held secrets.[7] Officials maintain that revelation of this information would permit commercial competitors (or political adversaries) to undersell and thereby undercut Brazil's nascent productive capacity (Nazaré 1995c). Brazilian and U.S. officials declined in interviews with this researcher to estimate their present numbers, as did officials at the bilateral nuclear materials and accounting agency, ABACC. It is known, however, that the latest generation of ultracentrifuges in the Aramar facility were manufactured in Brazil using state-of-the-art carbon fiber materials (*OEdSP* 3/11/1994; Flores 1995).

Ingredients of Success

Attainment of enrichment capacity by the PATN depended on organizational and technical factors, as well as more purely political aspects that facilitated the aggregation of diverse interests into an enduring coalition. With regard to the former, the Navy served as a competent and dedicated bureaucratic proponent in the effort. Moreover, the program enjoyed budgetary, managerial, and programmatic continuity. As is explained in the subsequent section of this paper, creation and preservation of the PATN coalition was also facilitated by the intrinsic multivocality of dual-use technology, the idea of technological autonomy, and compartmentalization of information.

Leading Role of the Navy

The Brazilian Navy has long been interested in nuclear technologies, primarily as a means to power submarines (Castello Branco 1972:90-91; Füllgraf 1988:58-9, 121-3; Lima 1973:34), and it played a leading role in creation of the PATN. The Admiralty of the Navy Ministry approved this objective in December 1978, toward the end of the Geisel administration. The

[7] Brazil reportedly developed machines capable of five separative work units by 1990, and sought to develop machines in the range of 18-25 units, roughly comparable to the most advanced commercial systems produced by URENCO, the European consortium of Holland, Germany, and the United Kingdom (Pinheiro da Silva in *Diário* 1990:5718). As of 1993, COPESP director Pinheiro da Silva envisioned production of 5,600 ultracentrifuges operating in fourteen cascades, roughly adequate to produce 5.5 tons of fuel per year (Cavagnari 1993:18, who cites *OEdSP* 2/28/93). Some 1000 ultracentrifuges were reportedly in operation by 1995 (Agência Estado translated in BBC Summary of World Broadcasts 11/10/95).

specific proposal was based on a report composed by then-Lt. Colonel Othon Luiz Pinheiro da Silva following his return from graduate training in nuclear engineering at the Massachusetts Institute of Technology.[8]

Pinheiro da Silva was assigned responsibility for assembling and supervising a team of researchers, which he recruited from diverse civilian and military sectors. Although their efforts initially focused on laser enrichment and were carried out jointly with Air Force researchers, the Navy team concluded by June 1979 that concrete results would not be attainable within a decade, and hence turned to the less theoretically exciting but more immediately promising ultracentrifuge approach. This choice of technology was fateful, as it permitted the Navy to achieve—in a brief period of time and with a relatively small application of human and financial resources—successful mastery of a reliable enrichment technology (Flores 1995; Fonseca 1995; Fonseca in *Diário* 1990:5705; Pinheiro da Silva 1995). Pinheiro da Silva established a close relationship with the civilian Institute of Technological Research (IPEN-Instituto de Pesquisas Energéticas e Nucleares) in São Paulo, which was in the late 1970s the only significant Brazilian research institution not administered by Nuclebrás. This disassociation reflected the commitment of its director, Dr. Romulo Ribeiro Pieroni, to shelter the center from international safeguards, which were uniformly required of institutions involved in the West German-Nuclebrás official program (Fonseca in *Diário* 1990:5705). Civilian researchers and technicians working in IPEN opposed the accord with West Germany and favored autonomous development (Flores 1995; Goldemberg 1996).

The enrichment effort by the Navy's Center for Research and Special Projects (COPESP-Coordenadoria para Projetos Especiais)—which directed enrichment development at IPEN and currently governs the industrial-scale Aramar ultracentrifuge plant—is the most consequential element of the PATN. It was the most successful among the three services, and its organization and history illustrate the process of sustaining a nuclear developmental coalition with limited resources and in the face of international and domestic political constraints.

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[8] This study was commissioned by Navy Minister Maximiano da Fonseca, who sought an assessment of Brazilian prospects for nuclear submarine propulsion, and was favorably received by him and Navy materials director, Admiral Mário César Flores. It noted that reliable access to nuclear fuel was essential to the viability of nuclear propulsion, and judged the jet nozzle approach unpromising and in any case circumscribed to strictly defined non-military applications. The study recognized that foreign support for propulsion development would not be forthcoming, and reportedly stressed that any alternative effort would need to avoid violating IAEA safeguards and other commitments made with respect to the official effort. It thus presumed that any project would need to operate within the constraints of Brazil's international legal commitments. Pinheiro da Silva's report was approved by the Naval Engineering Directorate in May 1978 and subsequently by the Navy Joint Chiefs of Staff (Flores 1995; Fonseca 1995; Fonseca in *Diário* 1990:5705; Pinheiro da Silva 1995).

While Navy and other officials have consistently maintained this account of the initiation of the PATN, doubts remain about dating the origins of autonomous nuclear efforts by the armed forces. While the Air Force was certainly involved in laser research since the early 1970s, authoritative sources disagree whether this was applied to enrichment. Nazaré stated and confirmed in a personal interview that although Air Force investigation of lasers began in 1974, this was only applied to enrichment in 1979. Nazaré dates initiation of the PATN as August 1979 (Nazaré 1990; 1995a; 1995c), as do many studies (e.g., Silva 1991). However, Leite contends that enrichment work was initiated in 1973 by UNICAMP professor Sergio Porto, who sought new applications of laser technology (Leite 1995; Malheiros 1993:80-1; Pinguelli Rosa et al 1991:94). One prominent nuclear physicist, Anselmo Páschoa, has asserted that he was personally approached to participate in an autonomous effort in 1976 and declined. However, PATN officials have consistently denied that efforts began before 1979 (Páschoa 1995a).

Navy officials speak proudly of their efforts; Pinheiro da Silva boasts that no country has ever attained enrichment capacity so inexpensively. Based on detailed internal cost accounting, he maintains that less than U.S. $200 million were expended on the effort. Navy Minister Flores testified before the Brazilian Congress that the exact figure was U.S. $180 million (Pinheiro da Silva 1995; Flores 1991). Verified accounting of PATN expenditures are not available (for a summary of available estimates, see Conca 1992:386 note #40).

PATN officials and outside observers cite a variety of factors as conducive to the Navy's accomplishments. COPESP coupled competent civilian researchers with the organizational capacity of a military organization (Flores 1995). But it did so in an unconventional fashion. COPESP did not function as a self-sufficient institution, but rather as an agency coordinating a decentralized set of diverse and geographically dispersed research projects. This is not an orthodox approach to management in the Brazilian Navy, which is oriented toward operating rather than creating technological systems. But it apparently permitted the organization to avoid military tendencies toward corporatism that might have made it larger but less effective (Pinheiro da Silva 1995).

The project enjoyed remarkable continuity, both in terms of the managerial discretion and fourteen-year tenure granted to Pinheiro da Silva as director of COPESP, and in the priority given to submarine propulsion by successive Navy ministers.[9] Pinheiro da Silva himself identified continuity in political support by the Navy and government as far more important than the quantity of resources available, in promoting technological development in Brazil as it is in other developing countries (1995).[10] Widely respected by allies as well as critics, Pinheiro da Silva proved an effective manager of technical as well as organizational dimensions of the effort. With respect to the former, his judgement was influential in leading the Navy to devote its efforts to the ultracentrifuge path to enrichment, to adopting a step-by-step, experimental approach to research and development, and to recruiting and retaining competent civilian technicians and researchers. Pinheiro da Silva depicted his managerial approach as motivating researchers through the realization of a series of concrete achievements, providing opportunities to inspire them to press forward. These milestones toward the mastery of enrichment also served to demonstrate to government officials that the Navy effort would be successful, and thereby allowed it to win greater resources from the CSN and CNEN (Páschoa 1995c; Pinheiro da Silva 1995; Castro Neves 1995).

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[9] The rationale behind Navy commitment to nuclear submarine propulsion and hence the PATN was first revealed in a professional service journal in 1988 ("Submarino de Propulsão Nuclear," published in *Revista Marítima Brasileira*; subsequently distributed by the Serviço de Documentação Geral da Marinha.) In this essay and in other public statements, as well as in interviews with this author, key Navy participants in the effort stress several characteristics of nuclear submarines—operation for long periods without surfacing, high speed, long range, and relative silence—as proffering invaluable military capabilities for a country with enormous ocean coastlines. These characteristics make such submarines ideal for defense and deterrence of foreign intervention. Although they do have offensive capabilities, their strategic rationale and the limitations of the overall Brazilian fleet make them at least arguably better suited for deterrent than for offensive missions (Braga 1995; Castello Branco 1995; Flores 1991; Flores 1995; Fonseca 1995; Pinheiro da Silva 1995; Saboia 1995; Vidigal 1995. For an independent appraisal of the submarine program, see Pinguelli Rosa et al 1990:13-28). Whatever the merits of this analysis, there was a solid and enduring consensus in the Navy that nuclear submarines would offer Brazil potent military capabilities otherwise unavailable. Their utility was underscored when a few British nuclear submarines effectively nullified the entire Argentine fleet during the Malvinas War in 1982. This consensus sustained commitment to carry out a project that—while not in accord with internal sectors favoring the existing surface fleet—did conform with longstanding service missions.

[10] Continuity of leadership and governmental support was also provided by the long tenure and firm support of CNEN President Nazaré. The program only foundered in the 1990s under Navy Minister Serpa, who was reportedly unsympathetic to the submarine effort (Rizzo de Oliveira 1995).

Continuity, Coordination, Complementary Projects

While the decision to initiate the effort was highly centralized, the diverse projects that comprised the PATN were only loosely coordinated. Although CNEN President Nazaré enjoyed great influence as technical advisor to CSN director Venturini, it does not appear that decision-making authority was ever formally or de facto delegated by the CSN to the CNEN. Nazaré was reportedly aware of all activities carried out by the military research and development units noted below, but only the respective military ministries and CSN had formal authority over them. Final decisions on significant policy endeavors and alterations were made by President Figueiredo, on the advice of his military advisors. Figueiredo assumed full responsibility for the development of the PATN in his testimony before the 1990 Parliamentary Commission of Inquiry (Rattes 1995).

Senior civilian officials in the Sarney government (1985-89) were aware of and supported the PATN, including the ultracentrifuge enrichment effort. The President was formally briefed on all Brazilian nuclear activities by the CSN, and approved the continuation of all existing projects (*OEdSP* 9/5/87; Castro Neves 1995). However, the blue-ribbon commission established by Sarney in 1985 to evaluate Brazilian nuclear policies was not authorized to evaluate the PATN.[11] The only changes in nuclear programs made by Sarney were his decisions to terminate work at the Cachimbo installation in 1986 (Nazaré 1995c; *FdSP* 3/20/87), and to modify the bureaucratic organization of the official program in 1988. The PATN thus enjoyed organizational continuity throughout the period 1979-1990, despite change of government and type of regime in 1985 (Garcia and Winkler 1995). It continued, moreover, to enjoy presidential support after the transition to civilian rule, albeit perhaps less enthusiastic than acquiescent.

In most areas of defense and strategic policy "Brazil operates with three independent armed forces" (Costa 1994:26), and the nuclear area was no exception to this general pattern. Each of the three military ministries had an organizational subunit dedicated to the PATN. The Navy's COPESP in São Paulo had responsibility for developing ultracentrifuge enrichment, small reactors, and nuclear submarine propulsion. The Air Force's Institute of Advanced Studies of the Aerospace Technology Center (IEA/CTA) in São José dos Campos, SP, carried out research on laser enrichment, on nuclear fuel cells for use in satellites, and on fast-breeder reactor technology. It was also assigned the task of exploring the possibilities of so-called peaceful nuclear explosives. The Army's Institute of Special Projects (IPE) in Guaratiba, RJ, developed a research graphite reactor. As there is no defense ministry in Brazil, the military ministries with jurisdiction over these centers answered directly, as did the CSN, to the President of the Republic.

The CSN oversaw the activities of the CNEN, which in turn supervised four civilian research institutions, three of which are affiliated with major universities: the Institute of Nuclear Engineering in the Federal University of Rio de Janeiro; the Institute of Nuclear Energy Research in the University of São Paulo; the Center of Nuclear Technological Development in the University of Belo Horizonte; and the independent Radiometry and Dosimetry Institute in Barra de Tijuca, RJ (*Organogram* undated).

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[11] Comissão de Avaliação do Programa Nuclear Brasileiro, typically referred to as the Vargas Commission for the name of its president. Its final report manifests, however, awareness of and support for ongoing ultracentrifuge and laser enrichment research (see *Avaliação* 1990:23, 42).

Relations between these civilian and military institutions varied. While the Army and Air Force worked in relative isolation from civilian specialists, the Navy's COPESP aggressively sought out civilian expertise from all of the centers listed above. These different patterns of civilian-military interaction may be explained in part as a manifestation of different institutional resources. The Air Force and Army had their own technical universities, while the Navy did not. The Navy overcame its lack of a nuclear engineering program by sending students abroad and through courses at the University of São Paulo (Castro Neves 1995; Pinheiro da Silva 1995).

Military leaders and participants deny that the division of projects among the services reflected either inter-service rivalry, or a political distribution of "slices" of the PATN fiscal "pie." Their claim seems valid with respect to the Navy and Air Force efforts, especially since their early endeavors were carried out in close collaboration. Pinheiro da Silva was assigned by the Navy to work in the Division of Advanced Studies of the Air Force's CTA, and the services made a joint presentation to the Presidency advocating a two-track approach of exploring both centrifuge and laser enrichment possibilities (Fonseca in *Diário* 1990:5705). While contact between the Navy and Army was apparently limited, the Navy and Air Force maintained an informal relationship of information interchange and cost sharing throughout the history of the PATN (Pinheiro da Silva in *Diário* 1990:5718-19). There was no inter-service conflict evident in the shift from joint laser research to the Navy's redirection toward ultracentrifuges (Fonseca 1995). Although pursuit of two approaches toward the same objective might be seen as unnecessary duplication, officials likewise deny that there was any redundancy and reject assertions that there were three parallel "programs." They argue instead that an appropriate characterization of the PATN is of a single coordinated program in which the three military services worked largely independently but on complementary projects (Pinheiro da Silva 1995).

However, while the PATN took advantage of existing objectives, competencies, and research efforts in the Air Force and Navy, the goal of developing a graphite reactor was *created* for the Army in 1979, and the primary effort during the first years of the Army's participation was construction of the IPE research center (Venturini 1995). While the Army project may have been beneficial, for example in providing safety experience handling plutonium in hot cells, the project was never a top priority and little money was expended on the effort. That any allocation was made at all may reflect less the intrinsic merits of the project, and more a certain "co-efficient of jealousy" between the services (Castro Neves 1995); the Army is the largest and most politically consequential of the three services in Brazil. However, the graphite reactor project did not "fit" into any traditional Army mission, and it may hence have faced an uphill battle in the internal competition for limited resources within that service.

Financial resources for the PATN came from the three services, the CNEN, and the CSN. While the Navy and Air Force enjoyed substantial "income" from the provision of maritime and air control services, Army efforts were more heavily dependent on funds provided by the CSN. These were discretionary funds available to the Presidency from the Ministries of Planning and of the Treasury (Venturini 1995). The Navy's relative success in comparison with the other projects led to expansion of its projects, and greater funds were correspondingly allocated to the Navy effort (Castro Neves 1995).[12] The CSN sustained funding in the

[12] Due to the greater dimension and industrial scale of the Navy effort, it receives substantially greater resources than the other services' projects. (Garcia and Winkler 1995).

late 1980s through secret bank accounts, by which monies hidden from congressional scrutiny were funneled to the PATN. This tactic was apparently adopted to circumvent cuts in commercial energy funding imposed under an austerity plan reached with Brazil's international creditors (Malheiros 1993:83-92, Spector with Smith 1990:246). This practice continued when the CSN was replaced by the Strategic Affairs Secretariat (SAE) in 1990 (*Veja* 8/14/91:24). However, as "black" budgeting was reportedly eliminated following the 1990 congressional investigation into the PATN, SAE financial participation dwindled and the individual services came to bear the brunt of funding (Garcia and Winkler 1995).

This combination of continuity in presidential support, lengthy tenure for key officials, continuing access to financial resources, and loose coordination facilitated development of the PATN. The potential for inter-coalition competition was minimized by several factors. Service projects were independent in implementation and largely so in funding, as well as complementary in purpose. Also, a project was created to give the Army—politically dominant among the three Brazilian armed services—a stake in the enterprise. Moreover, Presidents Figueiredo and Sarney did not intervene to impose greater efficiency in the allocation of resources by cutting unnecessary projects. No project was canceled for "failure," and the increasing financial allocations to Navy projects were perceived as based on their technical merits.

Viable Technology, Indigenous Effort, Foreign Resources

The pursuit of uranium enrichment in Brazil was carried out by three separate organizations exploring different technological approaches. The official effort sought to develop the jet nozzle approach with West Germany, the Air Force focused on laser development, while the Navy collaborated with civilian researchers to successfully develop ultracentrifuge enrichment. This latter choice was consequential. Not only was the Navy the service most committed to the effort, but this process has proven efficacious in every national context in which it has been undertaken, as it is easier to develop and less energy-intensive than alternatives. While the Figueiredo administration approved the pursuit of multiple paths, that which progressed most quickly—the ultracentrifuge effort—was rewarded by increasing financial resources. While the selection of appropriate technology by a dedicated and competent agency was far from sufficient, it appears to have been a necessary condition to permit success.

Although the PATN relied primarily on indigenous sources for technological development, foreign sources were exploited to address some needs, including human resources, special equipment, and nuclear materials. COPESP director Pinheiro da Silva and key scientists involved in Air Force enrichment research were trained in graduate institutions in the United States. The IPEN—which worked with the Navy's COPESP on enrichment—contracted technicians trained abroad, many in Germany under the auspices of Nuclebrás, as the PATN displaced the official effort (*Veja* 9/9/87:25; Goldemberg 1996).[13] While the technologies employed in the IPEN/COPESP ultracentrifuge and the official jet nozzle programs are quite different, technical training in Germany may have aided in improving

[13] Perhaps twenty percent of Brazilian technicians trained in the official program were transferred by 1987 to other sectors (Spector with Smith 1990:252-3, who cite an estimate by the German Foreign Ministry in response to a West German parliamentary investigation into clandestine nuclear exports).

overall quality control and the handling of corrosive hexafluoride gas used in enrichment plants (Albright 1898:20). Two hundred kilograms of this essential material, moreover, were covertly imported from China for use at IPEN before Brazil developed its enrichment capacity (Venturini in *Diário* 1990:5710; Malheiros 1994:120). As noted earlier, the 1987 enrichment announcement was delayed to allow for clandestine importation of key machinery, which included a special West German lathe used to precision-machine ultracentrifuges. This was reportedly obtained by Pinheiro da Silva on the pretense that it would be used for rocket shell production (Spector with Smith 1990:251, who cite *JdB* 5/22/88, translated in JPRS-TND 6/16/88:1). Thus in at least these three ways, foreign resources were exploited to overcome technical hurdles in the enrichment effort.

III: Motivations

The overall objectives, focus on enrichment, and specific projects involved in the PATN reflected diverse civilian and military motivations. This permitted assembly of human, financial, organizational, and political resources necessary to win governmental support and sustain the program over time. PATN coordinator Nazaré recounted that because "Brazil is a poor country," it was necessary to pool every possible resource that existed or that might be made available (Nazaré 1995c). As there are very few institutions with germane expertise, the PATN needed to exploit all national assets, from Air Force physicists, to Army nuclear engineers, to civilian specialists in many technical areas (Nazaré 1990:101-2; Pinheiro da Silva 1995). The Brazilian experience thus manifests difficulties faced by any developing country that seeks to reach an advanced state of nuclear development (Flank 1993; Poneman 1982).

For military officials and strategic analysts, Brazilian nuclear development was conditioned by the pace and direction of efforts in neighboring Argentina, as well as by the desire to attain the technological requisites befitting Brazilian aspirations to great power status. For civilians, this program offered a means to redress the limitations of the official effort with West Germany, and to promote autonomous Brazilian technological development. Beyond these general objectives, which are elaborated below, support for the many projects that comprised the PATN reflected more specific and in some cases contradictory motivations.

The formation and maintenance of this coalition was facilitated by three factors: the intrinsic multivocality of dual-use nuclear technology, the inclusive vision of technological autonomy, and the compartmentalization of information within the PATN. Actors with different priorities and values viewed enrichment technology as desirable for different reasons. As recounted in the preceding section, the Navy sought to develop submarine propulsion. Civilian technicians and scientists sought to participate in advanced research in the service of national development. The Army may have aspired to little more than avoiding its institutional exclusion from the effort. The Air Force pursued development of power sources for satellites. Sectors in the latter service and in the intelligence community reportedly sought atomic weapons. Latent contradictions in this heterogeneous coalition never became open fissures, because enrichment technology is a tool that can be employed toward multiple ends. All participants in the PATN coalition agreed on the importance of

technological autonomy, albeit without necessarily concurring on any clear definition of what this would entail. Incongruities between actors' objectives were obscured by secrecy within the effort, which limited the potential for conflict between disparate sectors.

Energy Crisis and Technological Autonomy

The central civilian figure in the PATN, CNEN director Nazaré, insisted in personal interviews that preoccupation with the Argentina program did *not* influence the PATN, and that the only military motivation involved was the Navy's interest in nuclear submarine propulsion. He noted that concurrent with initiation of the PATN, the Figueiredo administration initiated programs promoting solar and alcohol energy development, and argued that these efforts were driven by the generic imperative of overcoming Brazilian dependence on foreign energy sources. In addition to the general goal of autonomy, Nazaré and like-minded civilian technicians and researchers sought to develop small reactor technology and applications in medicine and agriculture (Nazaré 1995a).

Nazaré identified four changes that led from dedication of national resources toward the official effort in 1975, to the allocation of a significant and growing portion to the PATN just four years later: 1) realization that hydroelectric resources were not as limited as previously forecast; 2) recognition that vital hexafluoride gas technology would not be provided through the official program; 3) awareness that the jet nozzle approach would not be viable; and 4) tighter financial conditions that increased incentives to rely on national efforts rather then expend scarce hard currency to pay for imports (Nazaré 1995a).

Nazaré's account is quite plausible. Brazil's very limited petroleum resources—domestic sources met less than twenty percent of liquid fuel demand—left it extremely vulnerable to petroleum price increases. The 1970s energy crisis threatened the foundation of the military regime's claim on legitimacy—economic growth and stability—and therefore had a great impact on many foreign as well as domestic policies (Solingen 1990:124-5; Goldemberg 1982:139-40).[14]

Moreover, the 1978 U.S. Nonproliferation Act mandated termination of nuclear cooperation with countries that did not accept full-scope safeguards, i.e., IAEA inspections of all nuclear facilities. Thus contractual commitments to furnish fuel for the Angra I civilian power reactor, constructed by the U.S. firm Westinghouse, were made conditional on Brazilian acceptance of more extensive safeguards. The law took effect early in 1979, and by many accounts had a jarring impact on Brazilian policymakers (e.g., see Venturini in *Diário* 1990:5707). This U.S. policy shift threatened access to nuclear fuel for Angra I, the centerpiece of the official energy program, and Brazilian officials concluded that the United States could no longer be counted on as a reliable nuclear trading partner (Silva 1991:24; Castro Neves 1995; Nazaré 1990:100).[15] Furthermore, this U.S. measure to impede prolif-

[14] The regime responded by seeking international loans and promoting extractive and agricultural sector exports which, unlike industrial exports, did not require substantial liquid fuel inputs. As the debt burden escalated, they also turned to conservation and substitution policies. As the impact of the former was limited, they came to rely upon the second track of replacing gasoline with ethanol distilled from sugarcane. This proved unexpectedly successful due to the formation of a strong coalition of state and societal actors in support of the goal of "energy autonomy" (Goldemberg 1982:139-40, 147).

[15] Mistrust and resentment pervades Brazilian military evaluations of U.S. policies bearing on nuclear affairs. During the 1980s, the frequency of failures of the Angra I reactor reportedly even led military officers to allege deliberate sabotage (*Veja* 4/22/87:97).

eration may have had the unintended consequence of encouraging civilian nuclear scientists and technicians to participate in the autonomous effort—despite concerns regarding military control—in order to assure fuel supplies for research reactors (*Isto É* 9/16/87:73).

Rivalry with Argentina and Brazil As a World Power

Military participants' accounts, by contrast, range from mere acknowledgement to strong emphasis on military-strategic considerations. A former intelligence official long involved in nuclear affairs noted that Argentine selection of heavy water reactors was more conducive to military applications than the light water alternative. This and other indications led to the view that Argentina sought the nuclear option, the technological capacity to permit a political decision to acquire nuclear arms (Araripe 1995). The Argentine program troubled Brazilian officers because it was more advanced, shrouded in secrecy, and seen as partially motivated by military considerations (Teixeira 1994). Brazilian analysts understood Argentine strategic thought as viewing nuclear development as a means to compensate for Brazilian advantages in other measures of national power, as a "great tie-maker" (Castro Neves 1995; Abdenur 1995). It was believed that Argentina was close to achieving success in uranium enrichment in secret facilities, and this led to the conclusion that Brazil "had to have the capacity to build the bomb, in case Argentina were to do so." Moreover, nuclear development was one sphere of political competition with Brazil's rival for regional preeminence, and in this sense the PATN manifested "a race for prestige with Argentina" to be the first to master enrichment technology (Bocco 1989; Flores 1995; Fonseca 1995). Argentina was estimated to enjoy an advantage of six or seven years in advance of Brazil at the time the PATN was initiated (Venturini 1995).

The role of Argentina in Brazilian motivations should not be overestimated or misunderstood. Brazilian officers did not perceive a clear military threat, either nuclear or conventional in nature, from Argentina during this period (Costa 1993:204-210). Brazilian officials recognized that only extreme and uninfluential nationalist sectors in Argentina favored construction of atomic weapons (Araripe 1995; Flores 1995). Hence Brazil reportedly never engaged in research necessary to develop employable weapons (Castro Neves 1995). Nor is there any evidence that atomic weapons were ever integrated into Brazilian military planning or strategic doctrine (Costa 1995b). Army planning for threat scenario "Delta," which envisioned conventional war in South America and implicitly presumed that Argentina constituted the principal threat, relied solely on conventional defense and deterrence. Scenarios "Beta" and "Gamma," which envisioned nuclear conflict between the alliances led by the United States and Soviet Union, were only considered as theoretical possibilities (Cavagnari 1994:48-51, 61).

The Brazilian military sought to reach the same technological level that Argentina was on the verge of achieving: that of enrichment capacity and the resulting nuclear option. In this regard the technology itself was seen as a "species of deterrent;" the mere capacity to match a potential Argentine bomb was presumed sufficient to deter its construction (Castro Neves 1995; Pinheiro da Silva 1995). As one official observed with respect to the Army's graphite reactor project, the diverse PATN efforts sought in part to convey a general message to the Argentines: "watch your step; I can do it too, and I'm bigger than you are" (Anonymous 1995). Although rarely made explicit—especially in politically sensitive discussions of bilateral relations with Argentina—a notion of *latent technological deterrence*

is evident in Brazilian military and diplomatic thinking. Navy Minister Fonseca described this notion with his characteristic directness: "We don't need the bomb now, since there is no foreign enemy in sight. What we need is to retain the technology to have the capability to fabricate it should circumstances require." (*Veja* 4/22/87:94). Army Minister Pires Gonçalves, in defining the Army's position on nuclear affairs in anticipation of the 1988 Constitutional Convention, argued that Brazil had to prioritize nuclear development to become "a country with high technological development, and, therefore, strong and respected. This is deterrence by greatness" (*Notíciario do Exército* cited in *JdT* 6/1/87). A security policy specialist in the foreign ministry later wrote that

> dual-use technologies are valuable in themselves for the demonstration-effect of national competence, even if this competence is not necessarily translated into equipment of possible bellicose use…[because] evidence of a country's [technological] capacity has an important deterrent effect, by filling the absence of effective material power with the certainty that there exists capacity for rapid mobilization (Felício 1994:271).

In this sense the PATN was understood by some military and diplomatic officials as a means to *avoid* a nuclear arms race with Argentina.

But strategic and political considerations bearing on Argentina were only *one* element of a set of military-strategic considerations. These changed markedly as a result of bilateral rapprochement in 1979 and especially following transitions to civilian government in the mid-1980s. During the Sarney government from 1985-1989, political/strategic competition with Argentina declined markedly, and hence this factor faded from concerns motivating the PATN (Flores 1995; Pinheiro da Silva 1995).

The more fundamental and enduring motivation for the PATN was that it was viewed by military officers as a means to realize their ambition to enhance Brazil's international stature (Flores 1995). While the rationale for the PATN delineated in Exposição de Motivos [hereafter cited as E.M] #011/85[16] stressed that nuclear technological development was of national security interest for Brazil, it not only failed to refer specifically to Argentina as a consideration, but explicitly envisioned sharing the technology with other (albeit unspecified) Latin American countries. Such an expression would be unremarkable in grandiloquent diplomatic or presidential orations. That it was included as part of a very succinct rationale for autonomous nuclear development in a classified document is noteworthy. It suggests that decision makers' approval of the PATN was based on an understanding that political prestige would be acquired through technological mastery. In their vision, technological capability served as a latent asset in bolstering political prestige, rather than as an operational tool employed as force.[17]

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[16] This secret document was written by Venturini and approved by Figueiredo on February 21, 1985. It describes the overall rationale for the PATN, its goals and component projects, and the responsibilities of participating agencies. It is described in part in *FdSP* 5/14/95 p. 14, but was also made available to this author in a context that left no doubt as to its content or authenticity.

[17] Senior Brazilian military officials appear to have generally understood atomic weapons as offering political influence rather than military utility. Although there is little documentary evidence in this regard, the 1990 congressional testimony of former CSN chief Venturini is suggestive. Venturini recounted that the bombs dropped by the United States on Japan "were not done with military objectives....[but rather] to impress the world, in other words [as a] move at the highest level in the field of international relations. This must be recognized, gentlemen, because the atomic bomb produced the cold war." (*Diário* 1990:5711). Venturini's analysis was based on the revisionist history elaborated by Gar Alperovitz in *Atomic Diplomacy*. Although he did not directly mention the book in his congressional deposition, in a personal interview in his home he pulled out a well-worn copy from his bookshelf, which had been translated and published by the Brazilian Army Press, and recommended it highly to this author (Venturini 1995).

Technological development as a source of international and domestic prestige is a predominant theme in Brazilian strategic thought. The intrinsic connection of military considerations and technological development for a developing country such as Brazil is evident in the slogan that encapsulated Brazilian national security doctrine during military rule: *Security and Development*. While most studies of this doctrine emphasize its internal dimensions, with respect to Brazil's place in international affairs it stressed industrial and technological development to establish the requisites for military power. For Brazilian officers, defense and strategic affairs were *not* simply questions of manifest military power, but rather of industrial and especially technological development. This motivated a longstanding tradition of Brazilian military involvement in such key sectors as steel and petroleum, as well as in conventional defense industries.

The preeminent foreign policy aspiration of the Brazilian armed forces, *Brasil Potência*, has long been to make Brazil a great power on the world stage. Enhancing Brazil's international stature via military development of advanced dual-use technological capacities, moreover, served to maintain military autonomy from civilian society:

> One of the motives that has led the military to persist in seeking to carry out their principal R&D programs is the search for prestige for Brazil in international relations — or better stated, recognition of the force of the country by other powers, since if its force were recognized, it would be capable of reaching its goals and guaranteeing its interests without having to use that force. Furthermore, there is military determination to continue participating and directing a considerable part of Brazilian technological development. In the military vision, the mastery of the results of scientific-technological development will confer power on the armed forces (Cavagnari 1993:6).

Thus military conceptions of international politics, identification of Brazil's national security interests, and the services' corporate interests with respect to society converged in the area of technological development.[18] This orientation offered particularly congenial grounds for alliance with civilians oriented more "purely" by the quest for national technological autonomy.

IV: Insulation/Legitimation

International Impediments

Development of the PATN was shaped by international influences, notably the international nuclear nonproliferation regime. This regime and its primary advocate, the United States, imposed policies of technological denial to impede proliferation of nuclear weapons. Denial of viable enrichment technology in the 1975 accord with West Germany, however, helped

[18] On military determination to promote Brazil to great power status, see Cavagnari 1987; Cavagnari 1994; Miyamoto 1991; on military involvement in technological research and development, see Cavagnari 1989; Cavagnari 1993; for an example of military efforts to build public esteem through non-defense services to Brazil, see Bahiana 1974.

catalyze the effort that granted Brazil the technical capacity to develop such arms. Explicit international pressures in the 1970s, moreover, undercut domestic critics of non-pacific uses of nuclear energy, and incited determination among diverse Brazilian sectors to defy the international nonproliferation regime. Brazil's ambiguous nuclear status and the secrecy cloaking the PATN dampened international pressures and mitigated the severity of denial, which were overcome in part through clandestine foreign activities, but predominately through indigenous Brazilian efforts. Some regime norms did constrain Brazilian policy, but primarily only insofar as they were inculcated in domestic policy debates, institutions, and legislation.

International factors constrained policy options because officials viewed Brazil's foreign commitments as politically even when not legally binding, and because they made it impossible in practice to sustain a distinction between "peaceful" atomic explosives and nuclear weapons. These factors, moreover, bore on the evolution of the PATN because they limited the inclusiveness of the coalition that carried it out. Secrecy initially necessary to preserve the effort subsequently became a liability as it became necessary to legitimate the PATN before domestic audiences. Moreover, in reacting to the formation of the NPT, Brazilian officials justified their rejection of the treaty in part because it failed to stem the threat posed by the proliferation of atomic weapons in the arsenals of the nuclear powers. While they may have adopted this position instrumentally—rejecting the NPT on "ethical" grounds so as to preserve the option that Brazil could itself become a nuclear weapons power—their frequent denunciations solidified a domestic normative consensus against the bomb. Thus even as officials brought Brazil to the technical threshold of proliferation, they helped ensure that it would not cross it, by making any attempt to do so illegitimate among domestic constituencies.

Policy Constraints

Brazilian diplomatic rejection of the Nuclear Nonproliferation Treaty as discriminatory led many international observers to fear that this defiance was at best opportunistic free-riding on a regime that served Brazilian security, and at worst a façade for an attempt to acquire atomic weapons. Yet PATN officials stress the extent to which Brazilian nuclear development was constrained by Brazil's international legal commitments in safeguards agreements bearing on the official program, and by its political (albeit not until 1994 legal) commitment to the Treaty of Tlatelolco.[19] Officials cited the original 1978 Navy study of nuclear propulsion as framed by the assumption that any effort would need to avoid violating these commitments, and recalled their premature cancellation of negotiations to acquire French hexafluoride technology on the grounds that the legality of its acquisition would be compromised by any utilization in the PATN (Flores 1995; Pinheiro da Silva 1995; Venturini 1995). The secret framework document that delineated objectives and responsibilities for the PATN likewise stressed that all autonomous efforts comply with "our foreign commitments" (E.M. 011/85). Its author recalled the insistence of Foreign Minister Saraiva Guerreiro that in its indigenous nuclear efforts Brazil could not violate its international commitments (Venturini in *Diário* 1990:5714).

[19] Although Brazil ratified the 1968 treaty, it declined to waive a provision that the treaty would take effect only when all regional parties were members. As Argentina and Cuba never ratified the accord during this period, Brazil remained legally unconstrained.

Moreover, Brazil's international commitments were reportedly understood by President Figueiredo and his chief military advisor General Venturini as ruling out the acquisition of atomic weapons. While the President and CSN chief both approved Air Force efforts to develop PNEs (E.M. #011/85), when Air Force officials proposed to actually test such a device in late 1984, Figueiredo ordered an evaluation on both political and legal grounds. The CSN review concluded that any nuclear explosion would contradict the spirit although not the letter of the Treaty of Tlatelolco, and that Brazil's interests were to master the enrichment cycle and to avoid any activity that would be perceived as a bomb. Figueiredo decided against the proposal, and Venturini reportedly took pains to make clear to testing advocates in the Air Force that this decision was unequivocal (Venturini 1995). Thus even without being legally bound by formal accession to the NPT or waiver of Tlatelolco into force, and in marked contrast to the Brazilian diplomatic tradition of staunch defense of the right to develop PNEs, Brazilian policymakers found themselves constrained by the emerging normative and political consensus against proliferation and against the notion that any atomic explosion could be "peaceful."

Furthermore, through reiterated public declarations that Brazil did not seek atomic weapons but rather their abolition, Brazilian diplomats and leaders fostered a national normative consensus against the bomb, even as they nurtured the normative grounds for the pursuit of national technological autonomy. Thus national officials can make international norms salient in domestic policy debates to promote some policy alternatives while constraining others.[20] Coupling criticism of the nuclear powers as hypocritical and dangerous with rejection of the NPT as illegitimate and irrelevant helped establish opposition *both* to international inspections as well as to acquisition of the bomb. The Brazilian experience thus illustrates the *selective* incorporation of international norms of the nonproliferation regime, and offers a useful corrective to the notion that "the sheer existence of a regime puts an 'extra' burden of proof on regime opponents because in discourses about proper behavior of states and other regime actors, the regime structure serves automatically as frame of reference." (Müller 1995:383). Brazilian policymakers and opinion leaders did incorporate regime norms into national discourse, and they did so in reaction to the NPT regime. But they enjoyed a notable measure of agency—in choosing between the various and sometimes contradictory normative principles of the NPT regime—that contradicts Müller's formulation. International norms enter national discourses selectively, according to the policy preferences of dominant national elites. However, affirmations by such elites may—as they did in the Brazilian experience—come to bind their successors to a degree they do not anticipate.

The national normative consensus against the bomb was legally codified in September 1988 with the adoption of the new Brazilian Constitution, which mandated that "any nuclear activities within the national territory will be permitted only if for peaceful purposes and if approved by the National Congress."[21] This provision was weaker than that advocated by antinuclear activists and was in fact supported by the military/CNEN lobby, because it did not explicitly abrogate the right to develop PNEs or to enrich uranium outside of international safeguards, and established no mechanisms to implement civilian oversight. Nevertheless, this constitutional mandate established a normative precedent, which no

[20] See Cortell and Davis 1996, on modalities by which international norms may be introduced into national policy debates and legislation.

[21] Brazilian Constitution (1988), Article 12, cited in Spector with Smith 1990: 249-50.

subsequent nuclear policy or project could openly violate. Moreover, as described below, this constitutional provision was subsequently exploited by anti-bomb activists and policymakers in urging policy reforms and civilian control over nuclear development.

It was reportedly unnecessary to evaluate formally the costs and benefits of developing atomic weapons during the 1970s, as the option to do so was presumed latent in mastery of enrichment (Venturini 1995). However, by the time that capacity was realized in the context of civilian democratic rule and political rapprochement and economic integration with Argentina, it was no longer legitimate to even *consider* acquiring atomic weapons. Brazilian press coverage and public statements by all civilian officials in the late 1980s were characterized by the uniform rejection of atomic arms, i.e., by crystallization of a solid normative consensus against the bomb. All nuclear activities, and especially those under military control, had to run a gauntlet of societal and press accusations that they were or might be conducive to developing atomic weapons. Only those that could be successfully defended as serving legitimate civilian or non-weapon military objectives would survive in the 1990s.

Imposition of Secrecy

Constriction of policy options was not the only effect of the international nuclear nonproliferation regime. As or more importantly, the international context led Brazilian policymakers to develop the PATN in secrecy, which had significant consequences for coalition maintenance and policy trajectories. While in other regional and historical contexts national security considerations motivate tight secrecy in nuclear affairs, in this case the regional security context was relatively permissive. In the absence of disincentives from the international regime, Brazilian policymakers would not have developed the PATN in secrecy. Officials were keenly aware of the need to build public understanding and support for nuclear development (see Nazaré 1983; Nazaré 1987). Brazilian defense policy has long been characterized by deliberate demonstration of military and strategic capacities as both a tacit deterrent strategy with respect to possible regional adversaries, notably Argentina (Ponce de Azevedo 1996), and as a means to bolster regional and international prestige. Indeed, Brazilian aspirations for greater international stature would have been pursued through a "public" PATN. Officials would have given such a program as high a profile as the 1975 official effort, and in rhetoric bordering on hyperbole, as was the case in military promotion of the Brazilian conventional defense industry. But this policy alternative was effectively foreclosed by the political costs imposed by the international nuclear nonproliferation regime, and hence the PATN operated secretly.

During its early years secrecy was in fact necessary for the very survival of the PATN. While national and international observers suspected that autonomous efforts were underway, they were not able to make specific accusations. PATN officials and documents stress the need to maintain secrecy due to international pressures, particularly from the United States (Flores 1995; Fonseca in *Diário* 5706; E.M. #011/85), although some have acknowledged that secrecy was also maintained to avert domestic opposition (e.g., IPEN Director Cláudio Rodriguez in *JdT* 9/9/87). Opponents charge that secrecy served to shield the program from scientific critics, the Congress and opposition politicians, as well as from foreign actors, and thereby facilitated unsupervised access to state resources (Leite 1995; Goldemberg in *Diário* 1990:5724). Secrecy enabled the program to traverse the difficult and vulnerable stage before it succeeded in achieving independent mastery of the fuel cycle. It limited foreign pressures, and prevented foreign nonproliferation policy implementors from

targeting the PATN's technical and material vulnerabilities (Flores 1995). Secrecy, moreover, proved beneficial to internal PATN coalition formation and maintenance, as civilian advocates of technological autonomy were unaware of the support for atomic weapons development among some military sectors. It thus assuaged potential civilian opposition to the weapons option latent in dual-use nuclear technological development, while permitting "rogue" military elements to continue harboring aspirations for the bomb.

Yet secrecy became a serious liability following transition to civilian rule. Anti-nuclear groups emerged in civil society, and these were joined by critical and sometimes vindictive journalists and politicians who subjected military involvement in nuclear development to skeptical and at times openly antagonistic critique. Secrecy made the PATN and all of its component projects inherently suspect for these actors, whose largely negative attitudes toward the armed forces led them to assume that the primary military motivation for nuclear development would necessarily be the desire to acquire atomic weapons.[22] Furthermore, none of the institutions involved in the PATN were prepared to respond to rising public demands for accountability (Sardenberg 1996).

Military secrecy consequently fostered sensationalist and damaging press coverage. For example, revelation of secret PATN bank accounts in 1987 prompted a major Brazilian newsweekly, in an article entitled "The Bomb in the Basement," to assert that the PATN engaged in "international espionage under the pretext of hastening the advance of nuclear research in Brazil." It presented an image of the PATN congruent with perceptions of a suspicious public and civilian opinion leaders:

> For almost a decade an immense octopus, whose head is hidden under a cap, slithered surreptitiously in the nation's basements, to the fear of some and the delight of others. Baptized as the parallel nuclear program, this animal shelters more than 3,000 persons, between scientists, technicians, and workmen that live in its service and are well paid to do so. Its belly carries dozens of great industries that feed themselves from it. This is a voracious octopus, which squanders between 1 and 3 billion dollars per year, perhaps more. It is also a deep water mollusc: its budget does not appear in the books of the Budget Ministry, although all the money it spends comes from taxpayers' pockets, and its bank accounts, picturesquely named Delta Three, Delta Four, and who knows what other names, are clandestine (*Veja* 4/22/87:92).

A subsequent article described the PATN as "a network that functioned for years as centralized, secret, and omnipotent as the DOI, the centers of political repression that operated freely from 1970 to 1976" (*Veja* 9/9/87:24). Four years later, the same news journal protested that "With the exception of [SAE Secretary] Leoni Ramos and a minuscule group of bureaucrats and military officers, no one knows for certain what is being done, nor toward what ends, nor why, nor at what cost" (*Veja* 8/14/91:25). The program was viewed by critics in the scientific community as "an authoritarian fiefdom" under military control from which civilian society and its elected representatives were deliberately excluded (Pinguelli Rosa et al 1991:7). Secrecy provoked societal mistrust, and thus proved costly when it became necessary to legitimate the PATN before the Brazilian public.

[22] The 1990 nuclear policy review by the Collor Administration identified the following as contributing to anti-nuclear sentiment in Brazil: "association with military artifacts; the environment of secrecy that has characterized, at times unnecessarily, nuclear activities; concern about the effects of radiation; lack of confidence regarding the safety of nuclear installations; doubts about the existence of safe methods to handle and store radioactive wastes; and resource consumption by the nuclear program associated with their high costs." (GT/Pronen 1990:58).

Only those projects that could be successfully defended before these skeptical Brazilian audiences would survive as the process of civilian consolidation of democratic governance unfolded. The Cachimbo site and the Army graphite reactor could not meet this challenge and were curtailed.[23] In the increasingly transparent and contentious context of nuclear policymaking following the transition, the Navy's submarine and enrichment projects, by contrast, benefitted from proven technical achievements in an area with significant civilian technological spin-offs, and from the perceived legitimacy of their enterprises. National transparency and legitimate (i.e., non-bomb) objectives became political imperatives for the survival of PATN projects during the decade following the transition to democratic rule in 1985.

Domestic Challenges

The PATN faced two domestic "adversaries" during the 1980s and 1990s: bureaucratic actors and interests associated with the official program, and societal challenges to the autonomy and authority of the armed forces. The latter proved more difficult to surmount. Nevertheless, by increasing transparency, sacrificing projects and objectives deemed illegitimate by civilian sectors, and justifying their efforts through discourse that resonated with popular values and aspirations, the Brazilian military succeeded in maintaining a central role in nuclear technological development.

The PATN overcame its bureaucratic competitor—the official program—through technical accomplishments and the support of the armed forces. The former also aided in legitimating the program and military involvement in nuclear development, but PATN officials had to respond to numerous challenges in the press, the 1988 Constitutional Convention, and Congress. The culmination of civilian efforts to reduce military autonomy in nuclear affairs came during the Collor administration from 1990-1992. An attempt to transfer control over nuclear development to the Ministry of Science and Technology was apparently blocked by the armed forces; an administration policy review affirmed military contributions toward nuclear development; and congressional leaders initially suspicious or even antagonistic toward the services were converted in the course of a high-profile investigation into supporters of the PATN.

Displacement of the Official Program

Although international observers feared that technologies and human resources developed in the official effort might be diverted to the parallel program, the two efforts were de facto bureaucratic rivals for state resources and control over national nuclear endeavors. Disillusionment with the official effort prompted the PATN, and the latter came to enjoy increasing resources as the former stalled during the early 1980s (Sindicato…et al 1988:36-9; Füllgraf 1988:93-5). The 1985 review of the official nuclear program by the Vargas Commission prompted a struggle over nuclear policy whose resolution strongly favored the PATN. The Commission proposed to divide the CNEN (which coordinated PATN activities) into two

[23] The graphite reactor was scaled down to demonstrate that it could not be used to generate plutonium for nuclear weapons (Albright 1990, who cites *OG* 9/16/90). Army Science and Technology Secretary Romero Lepesqueur nevertheless ignited subsequent controversy with the admission that the graphite reactor, although of insufficient size to produce sufficient plutonium for a bomb, would aid Brazil in gaining nuclear military capacity (*OEdSP* 2/2/92).

new agencies under the effective control of the Ministry of Mines and Energy (which supervised the official effort). CNEN president Nazaré reportedly exploited military backing to thwart this recommendation, and instead won new powers for his agency and its transfer to the jurisdiction of the Presidency (*Avaliação* 1990:42-3; Carvalho et al 1987:27-8). The PATN was strengthened further through the 1988 reorganization of the official program, which brought research facilities that had been transferred from Germany in the official effort under the supervision of the CNEN (Redick 1995:11-12; Sindicato…et al 1988:65-9). The 1990 review of nuclear policies by the Collor administration advised against division of the CNEN into research and licensing agencies, applauded the accomplishments of the PATN, and recommended large increases in funding for nuclear research projects under military control (GT/Pronen 1990).

While the outcomes of these struggles marked the steady displacement of the official effort by the PATN, the telling blow came with the 1987 enrichment announcement, which heralded termination of the official program's attempt to develop jet nozzle enrichment technology. Sarney's revelation that PATN researchers had mastered enrichment "fell like a bomb on Nuclebrás," as one of its directors told the press. By that time, some U.S. $350 million had been spent on the official enrichment effort, without surmounting the technical and industrial challenges involved. Beyond its comparatively greater expense and lesser success, the Nuclebrás program was particularly vulnerable due to the German withdrawal from the effort the preceding year (*OEdSP* 9/5/87; *OEdSP* 9/6/87; *GM* 9/8/87). PATN officials exploited their success with enrichment to garner support for the autonomous effort (Wrobel 1991:339), and thereby won the tacit competition with its programmatic and bureaucratic rival, in spite of the far greater financial resources and extensive international assistance provided to the official program.

Societal Contestation

Indignation resulting from decades of military rule, paternalistic and technocratic policymaking, and authoritarian censorship and repression fueled challenges to the PATN by organizations in civil society, the press, and some regional and national political leaders. Challenges to nuclear policies began during the *abertura*, a period of political liberalization during the last two military governments. As manifest in the outcry that led to the 1978 parliamentary investigation, the official nuclear energy program became a sort of "national villain" because of its "military image" and "military physiognomy." It served as a target for opponents of military government who could not express their opposition directly for fear of repression (Leite 1995[24]). As opposition candidates rode a wave of popular rejection of military rule in 1982, CSN Secretary Venturini intervened to preserve PATN control over the IPEN facility, where ultracentrifuge enrichment was under development. Initially under the jurisdiction of the state government of São Paulo, IPEN was transferred by presidential decree to the CNEN, as the surprise victory of a center-left opposition candidate threatened military control and secrecy over the installation (*Veja* 4/22/87:95; Sindicato…et al 1988:47-9).

Following transition to democratic government in 1985, societal groups emerged to challenge the PATN as costly, dangerous, environmentally destructive, and anti-democratic. Among the most important targets of anti-nuclear and environmental activism was the Navy's Aramar industrial-scale enrichment facility. While misinformation initially diverted

[24] Ironically, this prominent critic of the official nuclear program during the 1970s, like many other civilian scientists, later came to laud the Navy's success in mastering enrichment technology as a service to national technological development (Leite 1995).

public attention from the facility, deception intensified societal concerns when it was revealed that the installation would produce highly radioactive materials. Construction of a "Mechanical Components Factory" was initiated in May 1985, but before its official inauguration in 1988 the installation had to weather surprisingly strong local and national opposition.[25] Officials sought to mute criticism through a variety of measures. They planted vegetable gardens from which produce was provided free to area schools. Their public relations campaign employed nationalist slogans and distributed a cartoon pamphlet aimed at youth that explained through a contemporary nuclear fairy tale that "crossing the road is much more dangerous than working with radioactive elements." The inauguration date was not revealed in advance to hinder mass mobilization, and a large contingent of troops and armored vehicles was deployed to prevent disruption of the ceremony. Most importantly, PATN officials invited national and local opinion leaders to tour the center in order to calm fears that atomic weapons were being constructed.[26] Mass protests and resistance by environmental organizations and mayors of neighboring municipalities thus gave way to societal acquiescence (Sindicato…et al 1988:52, 85-6; *JdB* 12/19/87; *FdSP* 4/9/88; Fonseca 1995).

As described earlier in this section, the 1988 Constitution reflected struggle over nuclear policies and military autonomy. The Brazilian Society for the Advancement of Science presented a petition to Congress signed by 60,000 scientists, which called for the constitutional prohibition of "construction, storage, and transport of nuclear weapons" in the country. The measure was blocked by the military lobby and CNEN supporters in the convention, whose pressure led to substitution of a less-constraining provision interpreted as permitting "peaceful" nuclear explosive tests (Britto de Castro et al. 1989:26). The new constitution mandated legislative supervision of all nuclear policies. Although the national congress failed to establish mechanisms to implement this provision, this constitutional mandate was employed to launch the 1990 Parliamentary Commission of Inquiry (Rattes 1995).

As described below, this high-profile investigation helped create a national political consensus (albeit on shaky empirical grounds) that there had been a secret military plot to build and test the bomb, which in turn intensified international and domestic pressures to definitively foreclose the atomic weapon option via assured verification. This consensus also reflected damning criticism by the nuclear policy committee of the Brazilian Physicists Society, which produced a technical report concluding that the Aramar enrichment plant could enrich uranium to 90%, that such material might be used to construct an explosive within one month of a decision to do so, and that a limited-yield device could be tested in the shaft at the Cachimbo Air Force base (*OG* 7/12/90; Pinguelli Rosa et al 1990). The committee first presented the report to the government, but as no clarification was forthcoming, these estimates were made public and had an enormous repercussion (Pinguelli Rosa 1995; *OG* 7/12/90).[27]

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[25] On this struggle see Sindicato…et al 1988:44, 51-4, 73-86; on anti-bomb activism in Brazil see Pinguelli Rosa et al 1991:102-10

[26] Navy officials led in promoting national transparency regarding the PATN in 1987, by inviting opinion leaders and critics to tour the Aramar enrichment facility. They stressed in private interviews the importance of efforts to demonstrate to civilian elites and the Brazilian public that they were not building the bomb (Saboia 1995; Flores 1995).

[27] These assertions were based in part on technical advice provided by the U.S. nongovernmental organization Federation of Atomic Scientists and on a book about the U.S. Plowshares "peaceful" nuclear explosives program (Theodore Taylor and David Albright, "A Crude Nuclear Explosive Device," 1990, mimeo; Edward Teller, *The Constructive Use of Nuclear Explosives*, 1968, New York, McGraw Hill.) The report was released only after internal debate within the organization, as some scientists (Goldemberg and Páschoa in particular) contended that available evidence was not sufficient to conclude that the Cachimbo shaft was for testing an atomic explosive.

Congressional Investigation

The 1990 Parliamentary Commission of Inquiry (CPI) pressed for information regarding the funding, administration, and objectives of the PATN.[28] It questioned why the official program with West Germany had been displaced by the parallel effort, why the latter was carried out in secrecy, and sought to investigate cost and safety issues related to civilian energy generation.

The discursive arena provided by these hearings pitted former government officials involved in or sympathetic to the PATN against members of the Collor administration. In the ensuing debates, PATN participants succeeded in winning the support of formerly skeptical legislators, an effort facilitated by the resonance among legislators of their invocations of nationalism and technological autonomy. While the congressional resolution that authorized the investigation singled out the Navy as having made "fallacious and naive" claims regarding its success in promoting national technological capacity-building, the CPI concluded with resounding commendation of the success of the PATN—and in particular of the efforts of the Navy—in promoting national nuclear technological development, and urged that these indigenous efforts be encouraged and protected from external interference (*Resoluções* 1995; *Diário* 1990:5728)

PATN officials failed, however, to persuade legislators of the distinction between a PNE and the bomb, that Brazil should retain rights to the former, or that the Cachimbo site was anything other than an atomic testing ground. Collor administration officials did not contest the virtues of technological autonomy, but instead focused on maintaining the equivalence of "peaceful" and military atomic explosives, and recounting a secret plot among military sectors to build and explode atomic weapons at Cachimbo. This struggle received wide coverage in the national press, and by the conclusion of the investigation it was no longer credible to deny that there had (almost) been a "Brazilian Bomb."

Legislators demanded an explanation from PATN officials for the secrecy that had enveloped the autonomous nuclear program and excluded the Brazilian people and their elected representatives from such a consequential national endeavor. Admiral Fonseca claimed that secrecy was necessary to protect the nascent program from "terrible international pressure....Principally American. They led all of this"[29] (*Diário* 1990:5706). The

[28] Hearings between July and November 1990 included testimony from former Navy Minister Admiral Maximiano de Fonseca; former CSN chief General Danilo Venturini; former CNEN President Rex Nazaré Alves; former Minister of Science and Technology Renato Archer; former COPESP director Rear Admiral Othon Luiz Pinheiro da Silva; CNEN President José Luiz de Santana Carvalho; Science and Technology Minister José Goldemberg; SAE Secretary Pedro Paulo de Leoni Ramos; and former President João de Baptista Figueiredo. One notable figure not called to testify was former CTA director Brigadier Hugo de Oliveira Piva, although legislators visited the Air Force center as well as other sensitive military facilities at Aramar, the Cachimbo testing grounds, and the Army's graphite reactor project. While portions of testimony were later published, the committee went into closed session during the testimony of Venturini and Nazaré, and the transcript of Figueiredo's testimony, which was taken at his home, was likewise declared secret for one decade (Rattes 1995).

[29] As in preceding CPIs on nuclear affairs, denunciations of U.S. meddling were common. Venturini cited U.S. violation of its contractual obligations in refusing to supply fuel for the Angra I reactor, and recounted the history of U.S. non-tariff barriers to computer exports, as deliberate attempts to deny "Brazil the capacity to implement its own progress" (*Diário* 1990:5707; 5710). In the 1954 CPI, Archer had revealed U.S. confiscation of German centrifuges purchased by Brazil in the early 1950s. His criticism of the international nonproliferation regime reflects enduring resentment: "The problem is the nuclear weapons-free zone treaty in Latin America that established that we cannot have nuclear arms—we do not want and do not need them. Well then, they [the United States and other nuclear powers] can bring their navies with their nuclear arms and pass though here, enter our ports and do exercises and visits. The recognition of castes among countries is wrong-headed. Those that have and those that cannot have nuclear arms" (*Diário* 1990:5715). These complaints found a ready audience in the Brazilian legislature, grounded in the experience of two decades of conflictual U.S.-Brazilian relations (Lima and Hirst 1993).

CPI's final report criticized excessive centralization and secrecy. It demanded that Congress be informed of all nuclear developments in the country, while mandating exclusion of foreign observers from Brazilian facilities (*Diário* 1990:5728).

Although the CPI constituted a major civilian challenge to military autonomy, the outcome of the investigation was mixed with respect for the future role of the armed forces in nuclear development. While legislators pressed for greater congressional oversight over projects run by the services, they clearly gained greater confidence in the proficiency of the armed services in carrying out technological development, and were reassured that the Navy at least was not involved in the PATN to build the bomb. Few of their recommendations were ever implemented, however, in part because of limited follow-through,[30] but also because they were overtaken by diplomatic developments. Most significantly, the CPI proposal for congressional oversight in nuclear affairs was effectively supplanted by the bilateral inspection agency, the ABACC, established in conjunction with Argentina.

While this and the subsequent arrangement with the IAEA provide verified assurance that nuclear materials are not diverted to construct atomic weapons in Brazil, they inadvertently fostered continuity in military involvement in nuclear development. Societal and legislative challenges to military autonomy waned sharply as concerns that the armed forces sought the bomb were alleviated.

Executive Initiatives

The decision to initiate the PATN was made by President Figueiredo, and its trajectory was not altered by his successor. During the period 1985-1989, the PATN benefitted from the declining public standing of President Sarney, who depended increasingly on the armed forces for political support during his term in office (Hunter 1997:4). Notably, he withdrew from the commitment of president-elect Tancredo Neves to establish bilateral safeguards with Argentina, which would have exposed Brazil's emerging enrichment capacity.

Moreover, Sarney's announcement on the eve of the national independence day that Brazil had mastered uranium enrichment technology marked an apparent concession to his military supporters, although it presented the accomplishment as a product of civilian efforts (Britto de Castro et al. 1989:23). In a ceremony in the Planalto broadcast on national television at ten in the evening, Sarney was flanked by five civilian and four military ministers as he stated that "Brazilian scientists of the National Nuclear Energy Commission have succeeded in mastering the enrichment of uranium via the ultracentrifuge process. This is a fact of great transcendence in the scientific history of Brazil." The President's speech emphasized both the exclusively peaceful objectives of Brazilian nuclear development, and the importance of this achievement in furthering national scientific and technological autonomy. With regard to the latter, Sarney asserted that the broader significance of this feat was as a "symbol of the capacity of the Brazilian scientist, of his determination, his competence, a symbol of Brazil's unbeatable vocation for modernity." (*OEdSP* 9/5/87).[31] While Sarney's support may have reflected more tolerance than ardor, this first official acknowledgement of the PATN undoubtedly helped legitimate the effort.

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[30] The Brazilian Congress has manifested intense but sporadic interest in nuclear affairs. Executive officials complained in 1995 that legislative inaction had prevented passage for more than two years of a bill (Projeto de Lei No. 2.501-A de 1992) that would substantially increase transparency and congressional oversight in nuclear policymaking.

[31] Current Brazilian President Fernando Henrique Cardoso—then leader of the PMDB party in the Senate and longtime critic of the parallel program and of the acquisition of atomic weapons—was among the first to personally congratulate Sarney and concurred that this marked "a victory of the scientific community" (*Veja* 9/9/87:20; *FdSP* 9/6/87).

Although holding office for only two years before being impeached, President Fernando Collor enjoyed great popularity in 1990 and was unconstrained—as had been his predecessor—by dependence on the armed forces for political backing. Collor engaged in a forceful albeit unsystematic effort to reduce the prerogatives of the military. He replaced the military-dominated National Information Service with the Strategic Affairs Secretariat (SAE), appointed a businessman as its secretary, and staffed the agency with civilians and diplomats. His appointees to the military ministries were distinguished as non-political professionals. Collor made substantial cuts in defense spending, and increased the role of Itamaraty in security policymaking and the defense industries. He spurned military priorities through his environmental policies regarding the Amazon and lack of support for their prized satellite launch program. However, because the effectiveness of his ad hoc approach to policymaking reflected the highly variable level of his personal interest and intervention to ensure implementation, effects of these initiatives were limited.

In the nuclear area, Collor selected José Goldemberg, former President of the Brazilian Physical Society and a staunch advocate of civilian control over nuclear programs, as his new Secretary of Science and Technology. He asserted control over the CNEN by putting it under the jurisdiction of the SAE and replacing its pro-military president, Rex Nazaré, with a supporter of civilian accountability, José Luiz de Santana Carvalho (Redick 1995:13). However, an initiative to transfer authority over the CNEN to Goldemberg's ministry failed, reportedly due to military opposition (*FdSP* 8/5/91).

Although the inter-ministerial nuclear review commission GT/Pronen was established by Collor in part to consolidate civilian control over nuclear policy and included three non-governmental scientists, the military reportedly issued guidelines to the committee designed to minimize public scrutiny (Britto de Castro et al. 1989:24). More importantly, its final report hailed successes achieved by the military services in implementing the PATN, and proposed to focus resources on efforts under military direction and boost funding to U.S. $1.5-2 billion over the next five years (GT/Pronen 1990; Malheiros 1994:105-8; Pinguelli Rosa et al 1991:131-6).

Collor's most striking challenge to military autonomy in nuclear affairs manifested his penchant for political theater. A talented showman, Collor invoked the authority of the presidency, the international press, and the United Nations through dramatic media events staged in New York City and the Amazon jungle. Surrounded by national and international journalists, and flanked by his "visibly ill at ease" military ministers, Collor threw two shovelfuls of lime into a hole drilled deep beneath the Cachimbo Air Force base in a remote area of the Amazon. Collor declared he had discovered that the shaft was to be used to test an atomic explosive, and his action symbolized the final "burial" of the scheme. His statements were summarized by the *New York Times* (10/5/90) thus: "Brazil Uncovers Plan by Military to Build Atom Bomb and Stops It." Before raising his shovel to "close" the hole, Collor reportedly told members of his staff that "These guys are crazy. They were really going to explode the bomb. This is absolutely true." (*Isto É* 9/26/90:23).

Collor had summoned his military ministers to Brasília the preceding week to provide a detailed briefing of nuclear activities under their supervision (*JdB* 9/19/90). Although ordered to join the presidential entourage at Cachimbo, they kept their distance so as to avoid appearing in photographs, and refused to comment for the press (*Isto É* 9/19/90; *FdSP* 9/26/90:24). The media event at Cachimbo was a deliberate "public humiliation of the military" that invoked Collor's authority as President of the Republic (Goldemberg 1994).

Collor's public "closure" of the Cachimbo shaft occurred one week before he delivered the introductory address to the 44th United Nations General Assembly. In a press conference with Brazilian journalists in New York, Collor disclosed additional details regarding the secret plan to develop atomic weapons. Code-named "Solimões," the effort was divided into four sub-elements likewise named for Amazonian tributaries. Science and Technology Minister Goldemberg and Environmental Minister José Lutzemberger, who accompanied the President, insisted that the only possible use of the Cachimbo shaft was for testing an atomic explosive device (*JdB* 9/19/90).[32] In his UN address (published in its entirety in *OEdSP* 9/25/90), Collor unequivocally disavowed "peaceful" nuclear explosives, an unprecedented statement for a Brazilian president.

These initiatives made it politically untenable for the armed forces to seek atomic explosives, or even to merely retain the option to do so at some future time. After these authoritative public acts, military disobedience of Collor's renunciation of PNEs would clearly violate rules of legitimate behavior (Goldemberg 1994). Collor's initiatives were thus consequential with regard to the prospects for proliferation. They did not, however, uproot the armed forces from their central role in nuclear technological development.

Limited Civilian Control, Constrained Military Options

The 1990 parliamentary investigation and these executive initiatives marked both the extent and limitations of civilian challenges to the PATN and military involvement in national nuclear development. The armed forces succeeded in legitimating their role by contrasting their technical accomplishments against the expensive failure of the official program; highlighting civilian applications of nuclear technologies; increasing public and legislative access to information (though not decision making) on nuclear projects; relinquishing the legal possibility of developing atomic weapons; and exploiting the idea of technological autonomy to legitimate their involvement. However, military projects perceived as oriented toward atomic weapons—the Cachimbo installation and the Army's graphite reactor project—were curtailed. In a sense the Brazilian armed forces thus relinquished the theoretical option of constructing the bomb in tacit exchange for maintaining their tangible role in nuclear technological development (Conca 1992:390). But this was not an exchange that reflected their ideal preferences, especially as it was accompanied by long-reviled IAEA inspections of their nuclear facilities.

By demonstrating competent leadership that could reasonably be defended as not oriented toward the bomb, the Brazilian Navy succeeded in promoting its ambition to develop nuclear-propelled submarines. Its efforts also granted Brazil the latent technological capacity to construct atomic weapons. But technical capacity does not translate automatically into military capabilities. It is instead constrained, as the Brazilian experience illustrates, by the boundaries of legitimate action prevailing in national politics.

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[32] Empirical grounds for this assertion are at best uncertain. The shaft had been public knowledge since 1986 and had been abandoned since 1987. It does not appear to have been technically suitable for conducting nuclear tests, nor is Brazil believed to have possessed sufficient fissile material to produce a device at the time of its construction. In a recent interview with this author, Goldemberg stated repeatedly that despite a meticulous investigation in 1990-1991, he encountered no documentary evidence or other concrete proof of a military plot to develop the bomb (1996).

V: Conclusions

"Brazil must not be colonized through technological dependence"[33]

While senior military officials and technical specialists were well aware that the capacity to enrich uranium or produce plutonium is the key step in gaining the capability to develop atomic armaments, this investigation found no compelling evidence that such weapons were the primary objective of any of the three service efforts, or of the Figueiredo administration. Although elements within the armed forces and intelligence services advocated development of atomic explosives, and while some work was reportedly carried out by Air Force officers toward weapon design and construction of a possible nuclear test site, the preponderance of evidence available from official statements, private interviews, government documents, and independent analyses leads to the conclusion that what the Brazilian government and military services sought was the nuclear option. Unlike pre-Gulf War Iraq, for example, where the central objective of its secret nuclear program was to build nuclear weapons, Brazilian efforts sought *only* the technical capacity to permit a subsequent government decision to go for the bomb.[34] They were, moreover, driven as much or more strongly—even within the armed forces—toward non-weapon objectives, including marine propulsion and general technological capacity-building.

The military nuclear program in Brazil encountered challenging obstacles. These included financial, human, and technological resource constraints; the international nuclear nonproliferation regime; and domestic political opposition. The program benefitted from sustained political support from the executive and armed forces, and continuity in leadership and access to resources. The potential for inter-service rivalry was limited by decentralized funding and complementary projects, although the choice of enrichment technology did prove fateful for bureaucratic actors. Secrecy and the inherent ambiguity of dual-use nuclear technologies initially facilitated assembly of this programmatic coalition, although secrecy later became a liability as public legitimation of the program became necessary.

The vision of technological autonomy played an enduring and propitious role in this effort. This idea was a central "protagonist" in virtually every national nuclear drama in Brazil, notably the parliamentary investigations of 1954, 1978, and 1990, and gained allegiance because of widespread and enduring resentment of U.S. tutelage and hegemony. No divide separated civilians and military officers with respect to the allure of this ambition, and it was particularly appealing to the civilian scientific elite most outspoken against the bomb. The prominence of this idea in the Brazilian experience is by no means exceptional. The quest for technological autonomy characterized Argentina nuclear development, long the most advanced program in Latin America (Adler 1987). In fact, "In almost every case in the developing world, the drive for some form of technological autonomy supported the growth of a country's nuclear system." (Flank 1993:277).

In the Brazilian experience, the idea of technological autonomy fostered military and governmental consensus in support of the parallel program, elicited civilian participation in

[33] Placard at the Aramar ultracentrifuge enrichment plant (Deputy Mauro Campos in *Diário* 1990:5709).

[34] Although it is frequently assumed that Brazil sought nuclear weapons, analysts fail to ask why it does not have them. Given the country's industrial, financial, and technological resources, it could have developed atomic weapons long ago, had its leadership engaged in determined efforts to do so. Indeed, Brazil might well have built atomic weapons some twenty-five years ago, had there been a decision to do so in 1963 (Meyer 1984:131-2).

the coalition that carried it to fruition, and legitimated the effort before skeptical domestic audiences. Thus, at different moments and in different contexts, this idea played three distinct causal roles. First, it enabled successive administrations, bureaucratic agencies, and societal actors to identify how nuclear technologies would affect organizational and national interests, and thus guided decision making on policy alternatives. Second, it provided grounds for minimal consensus—a "lowest common denominator" upon which all could agree—for a diverse coalition of actors with distinct and partially inconsistent goals. Finally, it served as a potent rhetorical instrument in the hands of the armed forces in justifying the program and their participation in national nuclear development.

Ideas, Domestic Politics, and Proliferation

The causal weight of this particular idea reflected its affinity with more fundamental ideas in Brazilian political culture: nationalism, sovereignty, and modernity. The idea of technological autonomy—and those who wielded it—derived influence from its resonance with these abiding themes. But neither technological autonomy nor these more basic images provided justification for atomic weapons. On the contrary, nuclear arms advocates faced a national normative consensus against the bomb, a norm originating in the international nuclear nonproliferation regime. In rationalizing an ambiguous nuclear status that allowed Brazil to develop enrichment facilities outside of international safeguards, policymakers unwittingly helped circumscribe the range of actions their successors could legitimately pursue. Thus even the cynical use of norms can promote their inculcation.

These ideas alone did not determine the outcome of this nuclear experience: neither that Brazil would reach the nuclear threshold, nor that it would relinquish its hard-won nuclear option. Both ideas motivated, and were employed by, actors in political struggles over policy alternatives. These contests permitted the military to sustain their involvement in nuclear technological development, while undermining projects perceived as directed towards the bomb. But the outlines of this story were traced by understandings of the value of technological autonomy and the menace of the bomb, because these ideas framed the boundaries of reasonable and legitimate action in the Brazilian experience.

Few studies entirely ignore domestic processes and perceptions, but most research on proliferation has emphasized technological or security "imperatives" as predominant causal variables. This study, however, identifies domestic ideas and politics as primary determinants in taking Brazil to but not over the nuclear threshold. By explaining the formation and maintenance of a heterogeneous coalition, and the insulation and legitimation of an autonomous program, this analysis informs theoretical understanding of the processes by which proliferation does or does not occur. Even in a "realist" realm such as the proliferation of weapons of mass destruction, ideas enable, norms bind, and domestic political struggles govern state behavior.

Proliferation studies have recognized that ambiguous nuclear postures may reflect a range of behaviors and motivations: from a hidden effort to reach the bomb to mere preservation of policy options; from efforts to moderate international pressures to pursuit of bargaining leverage on other issues. But it has not been recognized that ambiguity has important consequences for the domestic and coalitional politics that shape nuclear policy trajectories. The multivocality of developing nuclear technologies allows potential cleavages to remain latent and encourages the coexistence of multiple understandings; it presents a

blank canvas upon which a variety of images may appear, depending upon the understandings orienting the actors. Hence movement toward the nuclear threshold may not reflect one coherent logic or necessarily indicate that even an unsafeguarded military program aims at the bomb.

The Brazilian experience illustrates how multiple understandings can coexist within one heterogeneous coalition, in which even military participation in nuclear technological development was partially motivated by the need to legitimate the armed forces in a region favored by the relative absence of interstate war. An external security threat can certainly unify such coalitions and meld latent cleavages between participating sectors. But so can other images, as did that of technological autonomy in Brazil. Promoting the technological independence of developing countries is not a priority of nonproliferation policy. But insofar as analysis ignores this motivation, it is apt to fail to appreciate both the potential determination and the possibilities for forbearance of nuclear programmatic coalitions in developing countries.

While some policy analysts have rightly cautioned that explicit international pressures may be counterproductive with respect to nonproliferation, few analysts have recognized that international norms can be remarkably potent, or that their influence may reflect unintended consequences of efforts to thwart the regimes from which they originate. Thus rhetorical and "symbolic" commitments—such as participation in nuclear weapons-free zones—are not inconsequential; the extent to which they contribute to the international delegitimation of nuclear weapons may be crucial to the prospects for nonproliferation.

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delegate, bilateral negotiations on Brazil-Argentina integration (1986-87)
member, Vargas Commission (1985-85)
representative, IAEA Board of Governors (1978-85)

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senior policy analyst, SAE

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