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BRAZIL, THE UNITED STATES, AND THE

MISSILE TECHNOLOGY CONTROL REGIME

by

SCOTT D. TOLLEFSON

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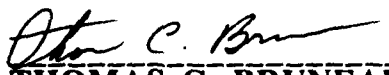

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The report concludes that the U.S. policy of restricting space and missile technology to Brazil under the MTCR has succeeded in stalling Brazil's missile program, but has also (1) further strained Brazilian security relations with the United States; (2) weakened U.S. influence over Brazil's rocket and missile programs; (3) strengthened Brazilian ties with European suppliers (especially France) of space and missile technology; (4) driven Brazil into closer technological cooperation with the People's Republic of China and the Soviet Union; and (5) intensified Brazilian negotiations with Iraq and Libya. As Brazil moves away from the United States (its traditional supplier of space and missile technology), it is becoming relatively more autonomous and less vulnerable to U.S. restrictions on space and missile technology.

The successful implementation of an internationalist development strategy by Brazil's new president, Fernando Collor de Mello, could provide the United States with an exceptional opportunity to improve relations with Brazil. The United States could possibly negotiate the easing of MTCR restrictions on space technology to Brazil without jeopardizing the goal of ballistic missile non-proliferation.

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The views expressed in this report are entirely those of the author, and should not be interpreted as representing the views of the individuals named above, or the official views of the U.S. Department of Defense, the U.S. Navy, the Naval Postgraduate School, or any other government agency.

INTRODUCTION

This report is a case study of Brazilian-U.S. relations under the Missile Technology Control Regime (MTCR). It analyzes Brazil's development of ballistic missiles in light of U.S. pressures to stifle that development.[1] Brazil, a leading Third World exporter of arms, has launched a series of sounding rockets and is now developing a ballistic missile that eventually could be topped with nuclear warheads. It has succeeded in enriching uranium, and may have the capacity to build nuclear weapons by

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[1] A ballistic missile is defined as a "self-propelled weapon-delivery system that is guided during a portion of its ascent, then follows a ballistic (unpowered and unguided) trajectory over the remainder of its flight path." Ballistic missiles are to be distinguished from cruise missiles, which are "powered by an air-breathing engine and are generally guided for their entire flight." Finally, tactical battlefield rockets are "generally unguided and have ranges well under 100 miles, but some can deliver warheads as large as those on many short- and medium-range missiles." Intercontinental ballistic missiles have a range in excess of 5,000 miles. Brazil already produces tactical battlefield rockets, and may be seeking a ballistic missile capability, although nowhere near the 5,000-mile range of an intercontinental ballistic missile. The sophistication of a cruise missile is still beyond Brazil's technological capability, but Brazil is "establishing industries that may eventually produce cruise missiles." Definitions from Robert D. Shuey, Warren W. Lenhart, Rodney A. Snyder, Warren H. Donnelly, James E. Mielke, and John D. Moteff, Missile Proliferation: Survey of Emerging Missile Forces, Congressional Research Service Report for Congress # 88-642F, Washington, D.C., 3 October 1988, pages 1, 9, and 44. Hereafter referred to as CRS Report.

the turn of the century.[2]

These events have alarmed U.S. policy-makers, and since 1987 the United States has restricted the export of rocket and ballistic missile technology to Brazil, under the terms of the MTCR. The restrictions have succeeded in stalling Brazil's satellite launch program as well as ballistic missile research and development, while straining U.S. security relations with Brazil, and prompting Brazil to explore closer ties with the People's Republic of China (PRC), the Soviet Union, and several countries in Europe and the Middle East.[3]

The major argument of this report is that Brazil is becoming relatively more autonomous as it develops its satellite launch rockets and technology that could be diverted to ballistic missiles, moving away from the United States (its traditional supplier of rocket technology), diversifying linkages with other suppliers, and becoming more self-sufficient. In the short term, Brazil is extremely sensitive and vulnerable to the limitations

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[2] Leonard S. Spector writes that "Within a few years, it is probable that Brazil will be able to produce unsafeguarded highly enriched uranium and, if it does so, it could develop a ready nuclear weapons capability - or even nuclear weapons themselves." The Undeclared Bomb (Cambridge, Massachusetts: Ballinger Publishing Company, 1988): 271.

[3] "Brazil Says Missile Technology Controls Hamper Launch Industry," Defense News 4, no. 30 (July 24, 1989): 18; "Satellite Launch Delayed by Technology Controls," (in Portuguese), Brasilia EBN, 2 March 1988, translated and reported in FBIS LAT-88-043 (Annex), 4 March 1988, 1.

placed by the United States on the transfer of such technology. In the long term, however, Brazil is likely to continue to diversify its sources of rocket and missile technology, thereby becoming less vulnerable (but not necessarily less sensitive) to U.S. restrictions.[4]

The study contains four sections: part I describes the MTCR in theory and in practice; part II analyzes the U.S. application of MTCR guidelines toward Brazil; part III assesses Brazil's ballistic missile capabilities; and part IV considers Brazil's response to the U.S. policy of denial. Based solely on unclassified sources, an extensive review of both Portuguese and English sources was aided by a DIALOG Information Retrieval Service search of the *PTS Defense Markets and Technology* database. Interviews were conducted with U.S. policy-makers in Washington, D.C. in June and July 1989. Research relating to Brazil's armaments industry was carried out in Brasília, Rio de Janeiro, São Paulo, and São José dos Campos.

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[4] For a discussion of "sensitivity" and "vulnerability" in international relations, see Robert O. Keohane and Joseph S. Nye, Power and Interdependence: World Politics in Transition (Boston: Little, Brown and Company, 1977), especially chapter one.

I. THE MISSILE TECHNOLOGY CONTROL REGIME

The Missile Technology Control Regime (MTCR) was announced by the United States, Canada, the Federal Republic of Germany (FRG), France, Italy, Japan, and the United Kingdom on 16 April 1987, after five years of intense negotiations [see Appendix for summaries of the MTCR]. The regime's thesis is that ballistic missiles are inherently destabilizing, especially when utilized as a delivery system for nuclear weapons. The purpose of the MTCR is to control the diffusion of technology that could be applied to ballistic missile development. The MTCR is not a treaty; rather, it is a supplier's regime with no central coordinating body, in which adherence to non-proliferation guidelines is strictly voluntary.[5]

In the "Equipment and Technology Annex" of the MTCR, two categories of export controls were established [see Appendix for "Summary of the Equipment and Technology Annex"]. Category I includes the most sensitive items, "complete rocket systems (including ballistic missile systems, space launch vehicles, and sounding rockets) and unmanned air vehicle systems (including cruise missile systems, target drones, and reconnaissance drones)

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[5] For an overview of the MTCR, see Frederick J. Hollinger, "The Missile Technology Control Regime: A Major New Arms Control Achievement," in Daniel Gallik, editor, World Military Expenditures and Arms Transfers 1987, U.S. Arms Control and Disarmament Agency Publication 128 (Washington, D.C.: U.S. Government Printing Office, March 1988): 26.

capable of delivering at least a 500 kilograms payload to a range of at least 300 kilometers as well as the specially-designed production facilities for these systems."[6] Also covered are complete subsystems including "individual rocket stages, reentry vehicles, solid or liquid fuel rocket engines, guidance sets, thrust vector controls, and warhead safing, arming, fuzing, and firing mechanisms." Requests for Category I items are meant to be denied by MTCR signatories except in the rarest of circumstances, and only with end-use guarantees by the recipient country. Category II items include propulsion components, propellants, structural materials, flight instruments, avionics, launch support equipment and facilities, computers, test equipment and facilities, and guidance and control components. Such items may be transferred on a case-by-case basis, at the sole discretion of the supplier, as long as such transfers do not facilitate the development or production of ballistic missiles.

A. The Implementation of the MTCR

In practice, there is broad latitude for interpreting the MTCR guidelines. In the United States, the implementation of the MTCR has been rigid. Requests for items in the MTCR annex, Category I, are invariably denied. Although more discretion is

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[6] Emphasis, author's.

allowed under Category II, such items are almost automatically denied. In contrast, France and the FRG have been less restrictive in the transfer of missile-related technology. In general, they are less inclined to restrict space technology that could be diverted to ballistic missiles, and technology for missiles below the MTCR thresholds (500 kilograms, 300 kilometers).[7]

The MTCR has achieved its more limited goal of delaying missile proliferation among developing countries. By restricting missile-related technology, the MTCR has succeeded in increasing the time and costs associated with the development of ballistic missiles. In Brazil, military officers have openly complained that their space programs have been hampered by the MTCR restrictions. According to one report, "the Brazilian authorities responsible for the Brazilian Complete Space Mission[8] have now become persuaded that it is not possible, at least in the short term, to count on arranging the transfer of the most modern foreign technology for the development of a medium-range missile."[9] The restrictions have led Brazil to seek suppliers

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[7] See Barbara Starr, Controlling the Spread of Ballistic Missiles," Jane's Defence Weekly, 22 April 1989, 696.

[8] In Portuguese, Missão Espacial Completa Brasileira (MECB).

[9] "Lacking Funds, Air Force Retires Piranha," (in Portuguese), Correio Braziliense, 6 August 1989, 16; translated and reported in Foreign Broadcast Information Service (hereafter referred to as FBIS) LAT-89-191, 4 October 1989, 37.

outside of the MTCR, and those suppliers within the MTCR that are willing to bend or break MTCR guidelines.[10]

B. General Critique of the MTCR

There are numerous problems associated with the MTCR.[11] First, and foremost, there is a lack of international consensus on the issue of ballistic missile proliferation. Edward J. Laurance argues that

> The effectiveness of controls is a function of the international consensus on the threat posed by the use of that type of weapon. This explains why the nuclear non-proliferation effort has been successful and why there is virtually no controls at all on a country's ability to acquire conventional weapons up to the level of howitzers and mortars through private channels. One could make a good argument that the Missile Technology Control Regime (MTCR) was only possible because of its clear linkage to nuclear non-proliferation.[12]

As Laurance suggests, to the extent that ballistic missiles are linked to nuclear weapons, consensus will be high, but consensus will be low when missiles are considered little more than major conventional weapons in the same category as advanced fighter

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[10] CRS Report, 12-13.

[11] For a superb critique of the MTCR, see Janne E. Nolan, "Ballistic Missiles in the Third World - The Limites of Nonproliferation," Arms Control Today, November 1989, 9-14.

[12] Laurance, "Responding to the Proliferation of Ballistic Missiles in the Third World: An Analysis of Potential Regimes," paper presented at the annual meeting of the International Security Studies, Section of the International Studies Association, Whittier College, November 1989, 22.

aircraft.

Lack of international consensus is apparent in the fact that two of the largest producers of missiles, the Soviet Union and the PRC, have not joined the MTCR. While the Soviets have vaguely stated that they will abide by the guidelines of the MTCR, they have not formally joined the MTCR.[13] The PRC, the fourth-largest exporter of weapons in the world, has refused to adhere to the MTCR. Its absence from the MTCR gives it virtually free rein in seeking a greater share of the ballistic missile market.[14] The PRC supplied Silkworm missiles to Iran, and in 1988 sold CSS-2 intermediate-range missiles to Saudi Arabia - after the MTCR was announced.[15] Those sales highlight the lack of consensus on ballistic missile non-proliferation and undermine the cartel-like character of the MTCR.

Second, there are no sanctions within the MTCR against countries or companies that break or bend MTCR guidelines. The United States, for example, was the main proponent of the MTCR, but cannot prohibit its allies that are co-signatories of the MTCR from loosely interpreting its guidelines. France, as noted

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[13] There is increasing evidence that the Soviets may sign the MTCR, but as of March 1990, that step had not been taken.

[14] CRS Report, 7.

[15] "Shultz Raps China for Building, Selling Missiles 'Around World'," The Sunday Herald (Monterey), 10 July 1988): 10A.

above, has been much more lenient than the United States in transferring space-related technology to Brazil and to the rest of the Third World. The United States has resorted to diplomacy and gentle persuasion in attempting to influence the French regarding this matter, but such prodding has been largely ineffectual.

Third, the MTCR fails to apply sanctions against those countries that utilize ballistic missiles in combat. Iran and Iraq, for example, made wide use of such missiles against each other (especially in the 1988 "War of the Cities"), but received little more than rhetorical condemnation from the international community.[16]

Fourth, the MTCR is resented by many developing countries, who consider it an attempt to "freeze" them out of the space or ballistic missile club, while MTCR members maintain their space programs and their weapons arsenals. Some of these countries, such as Brazil, Argentina, and North Korea, have not signed the nuclear non-proliferation treaty (NPT) and are even less inclined to join the MTCR.

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[16] For a review of Iran's missiles and a discussion of the "War of the Cities," see W. Seth Carus and Joseph S. Bermudez, "Iran's Growing Missile Forces," Jane's Defence Weekly 10, no. 3 (23 July 1988): 126. See also Stephen D. Goose, "Armed Conflicts in 1986, and the Iran-Iraq War," chapter 8 in Stockholm International Peace Research Institute, SIPRI Yearbook 1987: World Armaments and Disarmament (New York: Oxford University Press, 1987).

Fifth, the MTCR cannot control the black market of missile technology transfers. It is difficult to estimate the value of such transfers, but even minor activity in this realm can contribute significantly to the proliferation of ballistic missiles.

Sixth, and last, most of the problems associated with implementing the MTCR relate to dual-use technology (civilian technology with potential military applications). The preamble to the MTCR states that space technology will not be controlled by the regime, unless that technology can also be utilized in ballistic missiles. Most peaceful space-launch vehicles have inherent military applications. In effect, therefore, the MTCR controls much of the technology required for space-launch vehicles, a fact that is resented by developing countries with space programs. For the suppliers, there is no clear list of space technologies that could be diverted to ballistic missile programs. That lack of specificity has led to conflicts within and between supplier governments.[17]

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[17] "The one major component of a ballistic missile system that is not part of a space system is the reentry vehicle. Therefore, the regime includes all items associated with ballistic reentry vehicles as Category I items." Frederick J. Hollinger, "The Missile Technology Control Regime: A Major New Arms Control Achievement," in Daniel Gallik, editor, World Military Expenditures and Arms Transfers 1987, U.S. Arms Control and Disarmament Agency Publication 128 (Washington, D.C.: U.S. Government Printing Office, March 1988): 26.

While the ultimate goal of completely halting such proliferation remains elusive, the MTCR has succeeded in at least slowing the pace of ballistic missile development in countries where such programs depend heavily on imported technology, such as Brazil.[18] The remainder of the report looks at how Brazil has managed to press on with the development of a ballistic missile in the face of U.S. opposition, under the MTCR framework.

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[18] See the statement by Undersecretary of State for Security Assistance, Reginald Bartholomew, before the U.S. Senate Committee on Governmental Affairs. Thalif Deen, "U.S. Senator Urges Missile Curb," Jane's Defence Weekly, 3 June 1989, 1041.

II. U.S. POLICY

A U.S. policy-maker estimated that the U.S. has denied Brazil a modest "$5 million to $10 million" in space-related products since the MTCR was announced.[19] Nonetheless, the importance for U.S.-Brazilian relations of the MTCR-related issue may exceed that of broader trade disputes (in the billions of dollars) that continue to plague relations between the two countries. The space technology issue is especially sensitive because it strikes at the heart of Brazil's military and its perceived requirements for space and missile programs. Given the ongoing influence of Brazil's military elites, the issue may prove to be as divisive with the United States as that of nuclear development in the late 1970s.[20]

A. Bureaucratic Politics: Competing Views

Some of the complexities and dilemmas of the U.S. policy toward Brazil's space program can be partially understood in

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[19] Interview, anonymous, Washington, D.C., 26 June 1989.

[20] See Roger Cohen, "Brazil Fumes at Washington's Refusal to Allow Export of Certain Technology," The Wall Street Journal, 27 April 1989, A13.

terms of bureaucratic politics. The debate within the U.S. inter-agency group that applies MTCR guidelines to Brazil has been intense, but largely hidden from the public eye. Briefly, there are two major tendencies among U.S. policy-makers concerning the transfer of space and missile-related technology to Brazil. A relatively small group prefers to withhold virtually all such technology from Brazil, while another group prefers a more pragmatic, case-by-case policy. The former have generally prevailed, and with few exceptions, the U.S. policy of transferring space-related technology to Brazil has been one of denial.

All the exceptions to the policy of denial have been items within Category II, and most of them have been for Embraer, in technologies with no conceivable ballistic missile applications. A further exception was made in 1988 with the transfer of a bolt used for stage separation in the Sonda IV rocket, after a failed test launch of in October 1987. IAE experts, however, suspected that the cause of the failed launch was not in the bolt itself, but in the equipment utilized in ordering the stage separation.[21]

The policy of strictly interpreting and implementing the MTCR guidelines has numerous advantages. It (1) slows Brazil's

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[21] "Controversial ICBM, Other Projects Viewed," (in Portuguese), Folha de São Paulo, 21 July 1988, A-24, translated and reported in FBIS LAT-88-142, 25 July 1988, 34.

development of ballistic missile technology; (2) links Brazil's space and missile programs in realistic fashion (and if it commits an error in the process, it errs on the side of caution); and (3) caters tq moral sensibilities. In addition, such a policy is relatively easy to implement consistently, and gives its proponents an advantage in bureaucratic battles. In general, a uniform policy of denial has the upper hand in such disputes because it allows for few, if any exceptions.

Critics of present U.S. policy contend that in pursuing a policy of ballistic missile non-proliferation, the United States is (1) antagonizing a traditional ally; (2) eliminating any influence over Brazil's alleged missile program; (3) driving Brazil further into the waiting hands of the Chinese and Soviets; (4) ignoring Brazil's genuine interests in space technology; (5) exaggerating Brazil's nuclear capabilities; and (6) failing to take advantage of commercial opportunities. Finally, they argue that (7) a policy of denial, in a regime in which one is not the sole supplier, is ineffective - Brazil "will get there anyway."

In sum, U.S. policy-makers are faced with a dilemma: to what extent can they balance the goal of ballistic missile non-proliferation with that of improved U.S.-Brazilian relations? There are no easy answers to this question. U.S. policy options are rather limited, and reflect decreasing U.S. influence in the bilateral relationship and the concomitant rise of Brazil's

relative autonomy.

B. U.S. Concerns

1. Brazil's nuclear program

U.S. policy-makers have expressed a variety of concerns regarding Brazil's missile program. First and foremost, U.S. policy-makers fear that Brazil will achieve a nuclear weapons capability, and that the technology used to make the space rocket could be diverted to manufacture a medium-range ballistic missile capable of carrying an atomic bomb.[22] In September 1987 Brazil declared that it had mastered the uranium enrichment process and observers expect it to have the capacity to build nuclear weapons by the late-1990s. Brazil has the world's seventh-largest uranium reserves and is already planning to export enriched uranium in the next decade. It is developing a nuclear-powered submarine, and given the advanced state of its rocketry program,

[22] The concern is shared by a number of nuclear experts. See "Brazil Launches Rocket to Height of 350 Miles," Satellite News (8 May 1989): 6. See also "Obstacles to VLS Development Reviewed," (in Portuguese), Folha de São Paulo, 14 July 1989, G-3, translated and reported in FBIS LAT-89-156, 15 August 1989, 28.

has a lead over Argentina in missile technology.[23]

Brazil's nuclear program has been spurred by Brazil's rivalry with Argentina, which has the most advanced nuclear program in Latin America. Argentina is now capable of producing weapons-grade uranium, and the production of nuclear weapons is a matter of political will and financial investment. Brazil's program lags behind that of Argentina by only a few years.

Both Brazil and Argentina refuse to sign the 1968 Treaty on the Non-Proliferation of Nuclear Weapons, which gives the International Atomic Energy Agency (IAEA) the right to inspect nuclear installations of the 121 states that ratified the treaty. Brazil and Argentina have signed but are not bound by the Treaty of Tlatelolco, which seeks to make Latin America a nuclear-free zone.[24] Such treaties, they argue, are but an attempt by nuclear club members to exclude them from the system.

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[23] Leonard S. Spector, The Undeclared Bomb (Cambridge, Massachusetts, Ballinger Publishing Company, 1988). See also "South America: Brazil's Nuclear Program," Defense and Foreign Affairs Weekly, 13-19 May, 1985, 3.

[24] Both Brazil and Argentina have ratified the Treaty of Tlatelolco, but have failed to waive certain conditions that must be satisfied before the pact becomes binding on them. See Leonard S. Spector, The Undeclared Bomb (Cambridge, Massachusetts, Ballinger Publishing Company, 1988): 235, 259.

2. Brazil's policy and pattern of arms exports

A second concern raised by U.S. policy-makers is Brazil's arms export policy. Brazil places no "end-user" restrictions on arms sales, and allows recipients to retransfer Brazilian arms. The Middle East has long been Brazil's major market for arms. Iraq was Brazil's largest market in the 1980s, a position held by Libya in the late 1970s. U.S. policy-makers fear that Brazil might transfer technology or weapons to Libya, Iraq, and others in the Middle East.[25]

Brazil's missile and nuclear programs have implications for U.S. security concerns in the Middle East and Mediterranean. In early 1988, Libya reportedly ordered $2 billion worth of arms from Brazil, which had previously suspended the sale of weapons to Colonel Muammar el-Qaddafi. Brazilian civilian weapons manufacturers indicated they could lobby the government of Brazil into approving Libya's request, but after heavy pressure by the United States, Brazil backed down - at least temporarily. Today, Brazil's arms industry is facing a financial crisis and desperately depends on additional exports to survive.[26] With the termination of the Iraq-Iran confrontation, Brazil lost its

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[25] Bradley Graham, "Brazil's Arms Industry Competes Worldwide," Washington Post, 2 November 1986, D6.

[26] "A guerra em marcha à ré," Veja, 22 November 1989, 121; James Brooke, "Peace Unhealthy for Brazilian Arms Industry," The New York Times, 26 February 1990, A4.

largest market (Iraq). As a result, the Libyan market has become all the more appealing.

The coupling of missiles with chemical or biological weapons has not been mentioned by U.S. policy-makers as a major problem in relation to Brazil itself. On the other hand, a future Brazilian medium-range ballistic missile in the hands of the Libyans is an ongoing concern because of its possible chemical and biological applications.[27]

3. Brazil's potential threat to regional (Latin American) security

A third concern expressed by some U.S. policy-makers is that Brazil could strike almost any point in South America with a medium-range ballistic missile.[28] Such a weapon would raise the technological level of weapons, fuel an arms race, and generate instability in South America. Even more ominously, the coupling of Brazil's nuclear program with its missile technology has implications for Western Hemispheric security. To date,

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[27] For a discussion of ongoing U.S. concern with Libya's alleged production of chemical arms, see Michael R. Gordon, "U.S. Intelligence Aides Say Libya is Again Making Chemical Arms," The New York Times, 7 March 1990, A-1.

[28] See "In the World: Brazilian Missile Projects," African Defence Journal 82 (June 1987): 70.

Brazilian policy-makers have insisted that the nuclear program is for peaceful purposes only, and the 1988 Constitution states that nuclear energy must be utilized only for peaceful purposes. The very fact that the military is responsible for the nuclear program could suggest otherwise. Brazil has no external threat from South America and has sought to maintain a low regional profile, but its ten South American neighbors will probably be monitoring nervously Brazil's missile and nuclear weapons programs.

4. Brazil's potential threat to U.S. security

A fourth concern is that of Brazil posing a direct threat to U.S. security. Brazil could achieve nuclear weapons capability by the turn of the century. The coupling of a nuclear weapons capability with long-range ballistic missiles could threaten U.S. territory, and would raise new issues in hemispheric security relations.

5. Brazil as U.S. competitor

Finally, it is conceivable that a future Brazilian satellite launch capability or ballistic missiles could eventually compete with those of the United States in the world market. While such

a scenario seems unlikely given the advanced state of U.S. rocket and missile technology, it is no secret that Brazilian-made conventional weapons of low to medium technology are already competing with U.S. products.[29]

In summary, U.S. policy-makers are generally concerned most with security, and in relation to potential Brazilian missiles, express the greatest alarm regarding their relationship to the nuclear program (#1) and Brazil's liberal export policies (#2). The fear of U.S. policy-makers is that Brazil might sell ballistic missiles to a Libya that has achieved nuclear, chemical, or biological weapons capabilities. A direct threat to the United States (#4) would be of utmost worry if it materialized, but this scenario is considered implausible for decades to come. There is some concern expressed by U.S. policy-makers for regional security (#3), but virtually no mention is made of the competition factor (#5).

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[29] Some of the best examples include the Osório, a main battle tank produced by Engesa; the Tucano, a trainer made by Embraer; and the Astros II, a multiple launch rocket system (MLRS) manufactured by Avibrás.

III. BRAZIL'S BALLISTIC MISSILE PROGRAM

Brazil is only one of a number of developing countries that is developing ballistic missiles, and is joined in that pursuit by Argentina, Egypt, Iran, Iraq, Libya, Pakistan, South Africa, and Taiwan. Four other nations, Israel, India, North Korea, and South Korea, are already producing such missiles. Several countries have received complete missiles from the Soviet Union, such as Egypt, Iran, Iraq, North Korea, Libya, Syria, and South Yemen. Saudi Arabia became the first developing country to receive intermediate-range ballistic missiles from the PRC.[30]

The following section analyzes (a) Brazil's rationale for developing ballistic missiles; (b) the space program and its relationship to the missile program; (c) Brazil's current missile capabilities; and (d) problems facing Brazil's missile program.

A. Rationale

Why would Brazil want to seek a ballistic missile capability? There are at least four plausible rationales, of a (1) political, (2) economic, (3) security, and (4) technological

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[30] CRS Report, 2.

nature. Politically, missiles are one of the supreme symbols of national prestige and are virtual preconditions for great power status - especially when coupled with nuclear weapons. In a South America devoid of major external conflicts, the prestige rationale drives much of the arms transfers within the region and the missile programs in Argentina and Brazil. In some instances, the export of ballistic missiles can be utilized as instruments of foreign policy influence. In addition, a ballistic missile capability is perceived as a means toward greater autonomy and the ability to counter the influence of others. Finally, missiles can be used to assert ties with the Third World, through trade, licensing, and joint production.

Second, Brazil's development of ballistic missiles is driven by an economic rationale. The new product line could be very profitable, as there is significant demand internationally, if not domestically, for ballistic missiles. It is estimated that a Brazilian missile with a range of 300-1,000 kilometers would cost between $2 million and $5 million, and that a satellite launching vehicle (VLS) would cost $10 million on the international market. Sérgio Coeli do Prado, the operations director at Órbita, stated that

> Our initial project is to produce the Sonda IV rocket for scientific purposes in order to take advantage of an interesting nonmilitary market. But, as in any military-related industry, we are also studying the rocket's military applications, which would involve a

market of approximately $500 million per year.[31]

At a time when Brazil's armaments industry is reeling from the decline in demand for its weapons (partially a result of the end of the Gulf War),[32] there seems to be a commitment on the part of Brazilian policy-makers to support space-related ventures to compensate for the poor performance of arms exporters in the late 1980s. The Folha de São Paulo reported that "It's possible that the present combination of internal economic crisis and competition on the international market will force the domestic companies to march shoulder to shoulder to carve out a new niche in the market - in this case, artificial satellites for Third World countries."[33]

Third, Brazilian policy-makers may be concerned with security. Roberto Godoy, of O Estado de São Paulo writes that "the purchase of Brazilian-made missiles is part of the nationalization and self-sufficiency program the Air Force has

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[31] Eustaquio de Freitas, "Tactical Missile Development Reported," (in Portuguese), O Globo, 3 January 1988, 7, translated and reported in FBIS LAT-88-002, 5 January 1988, 21.

[32] In 1988, five of Brazil's major arms producers (Avibrás, Embraer, Engesa, Helibrás, and Órbita) experienced major losses, as measured by return on net assets, and only two reported gains (Bernardini and Vasconcellos). See J. Okubaro, "Arms Industry Ends 1988 in Red," (original in Portuguese), Jornal do Brasil, 30 April 1989, 31; translated and reported in FBIS LAT-89-114A, 3-4.

[33] "Joint Space Program Negotiated with Iraq," (in Portuguese), Folha de São Paulo, 19 March 1989, C-7, translated and reported in FBIS LAT-89-089, 10 May 1989, 43.

carried out over the past 10 years."[34] Domestically, Brazil requires air-to-air missiles for its 15 Mirage III and 26 F-5E fighter-bombers, in addition to the 79 AMX subsonic fighters it has on order. The MAA-1 Mol (formerly called the Piranha, but renamed in honor of Air Force Minister Octávio Moreira Lima), was designed for such purposes; its cancellation (see below) perpetuates Brazil's dependence on external suppliers. While none of the above-mentioned missiles fall under the MTCR parameters, they illustrate a concern with self-sufficiency that could later be applied to ballistic missiles.

In terms of an external threat, Brazilian policy-makers do not perceive an immediate threat from their traditional rival, Argentina. Some argue that the Argentine factor is irrelevant for Brazil's missile program: both Argentina and Brazil are bogged down in domestic economic problems; much of the rivalry between the two countries has dissipated; and relations between the two countries have never been better. On 8 April 1988, Brazilian President (1985-1990) José Sarney and Argentine President Raúl Alfonsín signed the Iperó Declaration on Nuclear Policy, which strengthened a previous accord on the cooperation of nuclear energy. In addition, the Brazilians and Argentines have opened their borders to increased trade, with a list of 524

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[34] "Development of Air-to-Air Missile Reported," (in Portuguese), O Estado de São Paulo, 7 January 1988, 2, translated and reported in FBIS LAT-88-008, 13 January 1988, 27.

tax-free capital goods.[35]

Despite such good will between the two countries, it is quite clear that Brazil's military is concerned about Argentina's missile capabilities and wants to "keep up with the Argentines" as they have in the nuclear sphere.[36] Argentina is developing a highly-sophisticated Condor II missile, in cooperation with Egypt and Iraq, a program that has been plagued by delays, insufficient funding, and the MTCR restrictions.[37] By most accounts, Brazil is ahead of Argentina in missile capabilities. Although the Argentines have been involved with the research and development of missiles longer than the Brazilians, Argentina has an infrastructure that is shallower than that of Brazil.

Fourth, Brazil's quest for advanced technology drives much of the space and ballistic missile program. The technology rationale is generally underestimated in the literature, but is

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[35] "Sarney Extols Cooperation with Argentina," (in Portuguese), Brasilia Domestic Service, 8 April 1988, translated and reported in FBIS LAT-88-069, 11 April 1988, 35-36.

[36] For a comparison of the Brazilian and Argentine nuclear programs, see Stephen M. Meyer, The Dynamics of Nuclear Proliferation (Chicago and London: The University of Chicago Press, 1984).

[37] U.S. restrictions through the MTCR framework have impacted more heavily on Brazil than Argentina. Historically, the United States has not cooperated as closely in space technology with Argentina as with Brazil. Argentina's missile program has been linked primarily with Europe - and as noted above, some European suppliers have not been as diligent as the United States in imposing MTCR restrictions.

often cited by Brazilian policy-makers, as exemplified by an official note released by the Air Force Ministry in May 1988, touting the advantages of the Missão Espacial Completa Brasileira (MECB - Brazilian Complete Space Mission):

> The development of high-level and far-reaching technology that will have an incalculable impact on the scientific, technological, and industrial sectors of our nation.
>
> The development of national technologies in the engineering and electronic sectors, thus contributing to the training of manpower that is totally Brazilian, and increasing the level of knowledge.
>
> ....the real cost [of developing the VLS] could never be evaluated because it would be imbedded in our own survival as a free and sovereign nation in the area of aerospace technology.[38]

Finally, it should be noted that the rationales discussed above are not mutually exclusive. The economic and technological rationales, for example, overlap considerably. In a general sense, they all fall under the category of "national security," which Brazilian policy-makers define in a broad manner.

B. Space Program as Precursor

According to the Congressional Research Service, countries can obtain missiles in six ways:

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[38] "Ministry Denies Explosion at Rocket Launch," (in Portuguese), Brasília EBN, 16 May 1988, translated and reported in FBIS LAT-88-097 (Annex), 19 May 1988, 1.

"1- most of the new missile powers buy or are given complete missiles;

2- a few countries convert short-range missiles into longer-range missiles or convert surface-to-air missiles into surface-to-surface missiles;

3- some countries are deriving military missile systems from space programs;

4- some countries are designing and building ballistic missiles using dedicated military industrial capacity;

5- more nations are developing, modifying, and producing ballistic missiles with technical and financial assistance and transfers of components, special materials, and information from other nations; and

6- a few countries are apparently taking steps toward the development and possible production of cruise missiles using aeronautical and electronic industries."[39]

The development of Brazil's missile program has been a combination of the above-mentioned strategies: a logical progression in the development of its weapons industry (#4); a product of external assistance (#5); an upgrading of existing missile technology (#2); and an application of civilian industries to the possible production of cruise missiles (#6). Most important, though, Brazil's missile program has its roots in the space program (#3), which provided the necessary, though insufficient technological base by which ballistic missiles might be produced.

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[39] CRS Report, 37.

The critical link between Brazil's space and ballistic missile programs is the satellite launch vehicle (VLS), which is virtually the same for both space and ballistic missile launches. A former head of the Centro Técnico Aerospacial (CTA - Aerospace Technical Center), retired Brigadier (then-Colonel) Hugo de Oliveira Piva, stated: "It is obvious that if we have a satellite launcher rocket it is relatively easy, although not as easy as some may think, to transform this launcher rocket into a ballistic missile." He added that the development of this highly sophisticated space technology "will make us familiar with those techniques that are also used to manufacture weapons."[40]

1. Origins

Brazil's space program has been directed by the military through the Air Force (or Aeronautics) Ministry. The ministry is in charge of the CTA, created in 1950 in São José dos Campos, near the city of São Paulo. The CTA is involved in research and development for the aerospace programs of the Air Force. In 1965 the Air Force Ministry created the Instituto de Atividades Espaciais (IAE - Space Activities Institute), which is one of several institutes within the CTA, and is responsible for

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[40] "Officials Comment on Government Nuclear Programs," (in Portuguese), Jornal do Brasil, 14 December 1983, 18, translated and reported in FBIS LAM-83-245, 20 December 1983, D1.

developing rockets. Since its creation, the IAE has tested over 2,000 rockets. In 1971 the Comissão Brasileira de Atividades Espaciais (COBAE - Brazilian Commission of Space Activities) was established and placed under the National Security Council.[41] COBAE is chaired by the head of the Estado Maior das Forças Armadas (EMFA - General Staff of the Armed Forces), and is in charge of the MECB.

On the civilian side, the space program is headed by the Instituto Nacional de Pesquisas Espaciais (INPE - National Institute of Space Research), which is roughly the CTA's counterpart. Presently, INPE is under the jurisdiction of the Ministry of Science and Technology.

2. Role of the United States

The United States played a central role in bolstering Brazil's space program, beginning with its financial and technological support for the CTA and INPE. In 1966, the United States supplied sounding (research) rockets, which were subsequently launched by Brazil. Based on that technology,

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[41] In 1988 the National Security Council became the Council of National Defense (CDN - Conselho de Defesa Nacional), a transformation in name only.

Brazil later developed larger boosters of its own. According to Captain Clifford P. Graham (U.S. Army), the ties between Brazil and the United States

> were generally along functional lines within the two governments: NASA worked with INPE, sharing data, helping develop and implement scientific experiments, and training the Institute's technicians and scientists. Likewise the U.S. Air Force, through the Brazilian Ministry of Aeronautics, established and maintained a number of data exchange agreements with CTA that covered such topics as weather forecasting and analysis, and the launching of sounding rockets.[42]

The major objective of the U.S. assistance to Brazil in space technology was political - to strengthen bilateral ties between the two countries. The economic objective, of having something done for the U.S. more cheaply by a local ally, was not a major concern. The military objective of cooperation on security matters was already covered by a 1952 military assistance agreement.

Brazil no longer relies as heavily on the United States for space technology. In 1977, it unveiled the MECB, an ambitious $1 billion program with the stated goal of attaining self-sufficiency in space technology. At that time, Brazil committed itself to launching, between 1989 and 1993, a series of four Brazilian-made satellites (two for weather forecasting and two

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[42] Graham, "The Brazilian Space Program and U.S. Foreign Policy Challenges," West Point, New York (United States Military Academy, Department of Geography); October 1989; unpublished report, 15.

for terrain photography) from a 500 square-mile VLS launch facility being built at Alcântara, in the northeastern state of Maranhão. The Alcântara site, which has already cost over $470 million, is the world's closest launch center to the equator, making it attractive for launches of geostationary satellites.[43] The Alcântara launch center was officially dedicated on 21 February 1990.[44] In addition to its indigenous research and development,[45] Brazil now cooperates in its space program with Canada, the European Space Agency, the Soviet Union, the PRC, and France.[46]

The initial reaction of the United States to the MECB was muted, as Brazil's space capabilities seemed rather modest at the time, and unworthy of undue worry. By the mid-1980s, with

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[43] Alcântara is 2.3 degrees south of the Equator. The Kourou launch center in French Guiana is 5 degrees north of the Equator. According to Jane's, "Alcântara's position provides a 25 percent fuel saving compared with Cape Canaveral." Jane's Spaceflight Directory, 1988-89 (Alexandria, Virginia: Jane's Information Group Inc., 1988): 489.

[44] "President Dedicates Alcântara Launch Center," (in Portuguese), Rede Globo Television, 21 February 1990, translated and reported in FBIS LAT-90-036, 22 February 1990, 34-35.

[45] It was estimated, for example, that 71 percent of the equipment utilized in Brazilian satellites is purchased from Brazilian companies. "First National Satellite Launch Planned for 1988," (in Portuguese), Brasilia Domestic Service, 17 October 1988, translated and reported in FBIS LAT-88-202, 19 October 1988, 31.

[46] CRS Report, 93; and Claudia Bensimon, "Agreement Signed on PRC Rocket Technology," (in Portuguese), Jornal do Brasil, 30 March 1989, 20, translated and reported in FBIS LAT-89-062A, 3 April 1989, 4.

concern mounting over the security threat of missile proliferation in the Third World (and especially in the Middle East), the narrow goal of improved relations with Brazil took a back seat to the broader goal of implementing the MTCR in consistent fashion.

Today, U.S. objectives in relation to Brazil's space program, as reflected in the MTCR, have changed. Why? Politically, Brazil moved away (but not against) the United States in the 1970s, as it sought closer relations with many Third World countries. In the security sphere, Brazil in 1977 unilaterally abrogated a 1952 military assistance agreement. Economically, Brazil emerged as a competitor to the United States in internatonal markets, posting large trade surpluses with the United States.

3. Civilian-Military Role Conflict

Within Brazil's space program, civilians are primarily responsible for satellite production, and the armed forces are in charge of developing launch pads and rockets. Despite such a division of labor, the armed forces have become the dominant actor in the space program. Most of the high-ranking positions

in the space program are occupied by military officers.[47] COBAE, charged with overseeing space policy in Brazil, is a joint civilian-military committee, but is headed by a military officer.[48]

Brazil's program of missile production is even more centralized than the space program in the hands of the armed forces. Following a meeting in June 1986 between six companies, EMFA, and the three military ministries, missile production was placed under the authority of the Comando Geral das Forças Armadas (CMFA - Armed Forces Joint Command). All missile manufacturers are required to submit current programs to the CMFA, which evaluates them and awards contracts.[49]

One of the major problems facing Brazil's space program is the divided authority between civilian (INPE) and military (CTA and IAE) entities, which have had strained relations over the past years. In general, the civilians have been more

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[47] Aaron Karp, "Ballistic Missiles in the Third World," International Security, Winter 1984-1985, 166; "Brazil Pursues Dream in Space," The Washington Post, 13 December 1984.

[48] "Brazil Plans to Launch its Own Satellites in 1990s," Aviation Week & Space Technology, 9 July 1984, 60.

[49] "Latin America: Centralizing Brazil's Missile Production," Defense & Foreign Affairs Weekly, 22 June 1986, 2-3.

internationalist and pragmatic than the military.[50] A controversy erupted over the delays experienced by the Air Force in producing a VLS by the targeted year, 1989. In March 1988 the Air Force announced that it could not build the VLS prior to 1992, blaming the delay on the fact that Brazil was no longer able to acquire the necessary components because of the MTCR restrictions on such technology. In contrast, INPE met the deadline in building the first of four satellites to be launched by the VLS.[51]

The director general of INPE, Marco Antonio Raupp, was fired in January 1989 after he insisted that Brazil contract launching services with the United States or another country. Raupp's argument was that Brazil could ill-afford to wait another three or four years to place the completed satellite into orbit.[52] The military countered that in order to meet the goals established in the MECB, Brazil must provide the launching

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[50] For a review of the debate, see Vinicius Doria, "Alcântara Site of a New Rocket Launching Center," (in Portuguese), Brasília EBN, 27 Mary 1988, translated and reported in FBIS LAT-88-109A, 7 June 1988, 2. See also Stéphane Chenard, "INSCOM: Brazil's Chinese Connection," Interavia Space Markets 5, no. 3 (August 1989): 189-191.

[51] The estimated cost of developing the Brazilian-made SCD-1 satellite was over $118 million. The purpose of the SCD-1 satellite is to collect meteorological information. See Graham Warwick, "Satellite Launcher Directory," Flight International, 11 January 1986, 30; and CRS Report, 90.

[52] "O espaço deve ser civil," (interview with Marco Antonio Raupp), Veja, 8 February 1989, 5-8.

vehicle. COBAE recommended that President José Sarney refuse to authorize the purchase of a foreign rocket to launch Brazil's satellite.[53]

In the wake of Raupp's ouster, INPE was nearly transferred to the Air Force - a move that would have virtually eliminated civilian participation in the space program.[54] Raupp's successor, Márcio Nogueira Barbosa, argued against the militarization of INPE, claiming that such a move would jeopardize cooperative space programs with other countries.[55] At best, Brazil will be able to launch the VLS in 1992.[56]

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[53] In an official note released on 16 May 1988, the Aeronautics Ministry stated its position in rhetorical fashion: "What would be more important for the country? Delay the schedule and launch our own rocket, or import technology and become dependent in a very important scientific and technological program that is thoroughly linked to the very roots of the nation as a whole?" "Ministry Denies Explosion at Rocket Launch," (in Portuguese), Brasília EBN, 16 May 1988, translated and reported in FBIS LAT-88-097 (Annex), 19 May 1988, 1. See also "Meteorological Satellite Launching Postponed," (in Portuguese), O Globo, 19 February 1989, 7, translated and reported in FBIS LAT 89-033, 21 February 1989, 46.

[54] "Transfer of INPE to Military Denied," (in Portuguese), O Estado de São Paulo, 27 January 1989, 10, translated and reported in FBIS LAT-89-036, 24 February 1989, 59.

[55] "New Head of Space Research Institute Appointed," (in Portuguese), Folha de São Paulo, 24 January 1989, C-6, translated and reported in FBIS LAT-89-017, 27 January 1989, 30; "Director Faces Difficult Year," (in Portuguese), O Globo, 29 January 1989, 34, translated and reported in FBIS LAT-89-036, 59.

[56] "Meteorological Satellite Launching Postponed," (in Portuguese), O Globo, 19 February 1989, 7, translated and reported in FBIS LAT 89-033, 21 February 1989, 46; "Brazil Shakes Up Space Program," Defense News, 13 February 1989, 31.

4. Sonda Program

In order to understand Brazil's potential for developing a ballistic missile, one must first look at its forerunner, the sounding rocket.[57] According to the Congressional Research Service, "Brazil used a stepping-stone approach based on the Sonda series of sounding rockets to develop the VLS. The Sonda I, II, III, and IV were used to develop and test technologies, and components that were used in the successive Sonda rockets are to be used in the VLS."[58] [See Table 1]

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[57] For a detailed description of Brazil's sounding rocket (Sonda) program, see Jane's Spaceflight Directory, 1988-89 (Alexandria, Virginia: Jane's Information Group Inc., 1989): 432.

[58] CRS Report, 90-91.

TABLE 1

SONDA ROCKETS

	Sonda I	Sonda II /IIA	Sonda III	Sonda IV	VLS
# Stages	Two	One	Two	Two	Four
Fuel Type	Solid	Solid	Solid	Solid	Solid
Payload (kg.)	5	62	61	500	115/160
Altitude (km)	100	180	600	600	750/650 (circular orbits)
First launch	1964	N/A	1976	1984	1992 (est.)
# Tests/ Experi-ments through 1989	200+	60	23	4	N/A

VLS = vehicle launch service
* through May 1988

Sources: Compiled from Jane's Spaceflight Directory, 1988-89 (Alexandria, Virginia: Jane's Information Group Inc., 1988): 432; Andrew Wilson, editor, Interavia Space Directory, 1989-90, previously Jane's Spaceflight Directory, (Alexandria, Virginia, Jane's Information Group, 1989): 310; Shuey, Robert D., et al., Missile Proliferation: Survey of Emerging Missile Forces (Washington, D.C.: Congressional Research Report for Congress, 3 October 1988): 91; Clifford P. Graham, "The Brazilian Space Program and U.S. Foreign Policy Challenges," West Point, New York (United States Military Academy, Department of Geography); October 1989; unpublished report, 5-7; Vinicius Doria, "Alcântara Site of a New Rocket Launching Center," (in Portuguese), Brasília EBN, 27 May 1988, translated and reported in FBIS LAT-88-109, 7 June 1988, 2.

The VLS employed in the Sondas are solid-propellant systems. The Sonda VLS can follow a pre-programmed flight profile, but it lacks the sophistication of an inertial guidance system.[59] Instead, the Sonda IV utilizes a secondary injection system to control the direction of thrust and, thereby, the rocket's line of flight. This system injects a liquid into the rocket nozzle to alter the thrust line of the propulsion without moving the nozzle.[60] The Sondas are test-launched from Barreira do Inferno (literally, "Barrier of Hell"), near the city of Natal in northeastern Brazil.[61] The fourth model of the Sonda IV rocket was successfully tested on 28 April 1989. The final launches are scheduled from Alcântara, which is closer than Barreira do Inferno to the equator, and considered safer because it is further removed from large population centers.[62]

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[59] Pierre Condom, "Brazil Aims for Self-Sufficiency in Space," Interavia, January 1986, 101.

[60] David Velupillai, "Brazil Joins the Rocket Business," Flight International, 6 August 1983, 383-384.

[61] By May 1988, there had been 19 such launch tests for the VLS rockets. See Vinicius Doria, "Alcântara Site of a New Rocket Launching Center," (in Portuguese), Brasilia EBN, 27 May 1988, translated and reported in FBIS LAT-88-109, 7 June 1988, 2.

[62] The first full-size test at the Alcântara site is projected for 1992. See "Space Agency to Test-Launch Rocket 16 May," (in Portuguese), Brasilia Domestic Service (radio), 2 May 1989, translated and reported in FBIS LAT-89-084, 3 May 1989, 41.

C. Current Missile Capabilities

What are Brazil's current missile capabilities? Given the secrecy that surrounds the missile program, there is no easy answer to this question. Press reports are contradictory and often exaggerate Brazil's capabilities. The following section addresses the military applications of Brazil's space program and current ballistic missile programs and capabilities.

1. Military applications of Brazil's space program

To what extent does Brazil's space program have military applications? The Sonda IV's satellite launch vehicle (VLS) could serve as the VLS for a ballistic missile in the future. The military applications of Brazil's space program, therefore, depend less on technological considerations than on political will. It should be stressed that the government of Brazil has gone on record to support its space satellite launch program, but not ballistic missile production. A common argument is that the Sonda IV is only a satellite launcher, and lacks the required accuracy for military utility.[63] Colonel Antonio Carlos Pedrosa, director of the IAE, argues that

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[63] "Brazil Pursues Dream in Space," Washington Post, 13 December 1984, 1f, 4f; "Third Launch for Brazil's Sonda IV," Defense & Foreign Affairs Weekly 13, no. 42 (1 November 1987): 4; Space Commerce Bulletin 2, no. 23 (6 December 1985): 7.

> Ours is a...civilian program. If the VLS was intended for military purposes, it would have to be manufactured in numbers, hundreds of them. We will manufacture no more than a few units. After all, whom will we attack? Our South American neighbors? This does not make sense."[64]

Some Brazilians make it clear that the military application of space-related technology is an option that is being explored, especially for its export potential. For example, Vito di Grassi, director of Órbita, and Pedro Angelo Vial, the spokesman for Avibrás Aerospacial S.C., have talked openly about exporting Brazilian-made tactical missiles.

Several measures seem to support the view that Brazilian policy-makers are considering the military application of the space program. First, most of the rocket technology developed since 1965 has been passed on to the country's burgeoning armaments industry. Second, as noted above, the space program is managed by Brazil's armed forces, which continue to control rocket and launch pad development. Third, Brazil has a plant that can produce up to 18 tons per day of solid rocket fuel, far surpassing the needs of the civilian program.[65]

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[64] Mauro Malin, "U.S. Policy Hinders Satellite Program," (in Portuguese), Jornal do Brasil, 6 November 1988, 12, translated and reported in FBIS LAT-88-217 (Annex), 9 November 1988, 2-3.

[65] "Brazil Pursues Dream in Space," Washington Post, 13 December 1984, 1f, 4f. According to Defense News, "Brazil's Andrade Gutierrez Quimica produces ammonium perchlorate, the basic material from which solid rocket fuel is produced. The firm's new $5 million plant can produce 50 metric tons of ammonium perchlorate

The development of the Sonda IV rocket has provided Brazil with the incipient technology to build intercontinental ballistic missiles. The Sonda IV has a range of 600 kilometers and can carry a 500 kilogram payload, and is therefore subject to MTCR restrictions.[66] Although the Sonda IV is purely civilian, it could potentially be converted to an ICBM (inter-continental ballistic missile). The transformation of the Sonda IV into an ICBM would require several more successful launches and a major technological leap, especially in payload shielding and guidance.[67] The Sonda IV may be the rocket on which the SS-1000 (by Avibrás) and the MB/EE-1000 (Órbita) are based (see discussion of these companies and missiles, below). The SS-1000 and the MB/EE-1000 do not exist as of yet, except as some future research and design project.[68]

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per year. Its entire output will be used domestically. A second plant to produce the chemical for export may be built." See "Brazil Produces Solid Rocket Fuel," Defense News 2, no. 30 (27 July 1987): 14.

[66] See Jane's Spaceflight Directory, 1988-89 (Alexandria, Virginia: Jane's Information Group Inc., 1988): 432; Andrew Wilson, editor, Interavia Space Directory, 1989-90 (previously Jane's Spaceflight Directory; Alexandria, Virginia, Jane's Information Group, 1989): 310.

[67] "In the World: Brazil to Produce ICBMs," African Defence Journal 70 (June 1986): 55.

[68] CRS Report, 92.

How long would it take Brazil to convert its present VLS project into a ballistic missile? Lieutenant Colonel Tiago da Silva Ribeiro, deputy director of IAE, argued in 1988 that it depends on the perception of threat. Under the present scenario of low threat perception, Ribeiro estimates that the conversion would take Brazil ten years. In a situation of high threat perception, though, the conversion would take between three to five years, depending on the level of government commitment.[69] Such estimates are probably too optimistic, given Brazil's financial and technological bottlenecks.

2. Current ballistic missile projects

Brazil has a modest industrial infrastructure and several firms that could be mobilized if a future decision were made to produce ballistic missiles.[70] The two largest companies involved with the production of ballistic missiles are Avibrás, the traditional producer, and Órbita, the newcomer.

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[69] Mauro Malin, "U.S. Policy Hinders Satellite Program," (in Portuguese), Jornal do Brasil, 6 November 1988, 12, translated and reported in FBIS LAT-88-217 (Annex), 9 November 1988, 2-3.

[70] For a review of Brazil's current missile projects, see "In the World: Brazilian Missile Projects," African Defence Journal 82 (June 1987): 70.

a) Avibrás

Avibrás was created as a private aerospace firm in 1961 by engineers formerly associated with the CTA. In 1964 Avibrás was granted the Sonda I rocket contract, and has since been the major firm involved with the development of sounding rockets (Sondas II, III, and IV).[71] Today Avibrás works almost exclusively with the manufacturing of rockets and multiple launch rocket systems (MLRS) such as the Astros II. It is developing anti-tank[72] and anti-ship missiles.[73] Its most famous and profitable product is the Astros II, which can launch, with varying ranges, rockets of different calibers. The launcher fires SS-30 rockets up to 30 kilometers, SS-40 rockets up to 35 kilometers, and SS-60 rockets up to 60 kilometers.[74] Avibrás has sold an estimated 66 Astros

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[71] For a review of Avibrás and its space activities, see "A High-Tech Company with a Clear View to Simplicity," Military Technology 13, no. 8 (August 1989): 52-55; "Brazilian Manufacturer Cuts Back," Defense News 4, no. 6 (6 February 1989): 33; and John Hoyt Williams, "Brazil Reaches for the Stars," The Retired Officer, March 1989, 25-30.

[72] "Brazilian Missile," Aviation Week & Space Technology, 28 August 1989, 11.

[73] Avibrás is developing the Barracuda family of anti-ship missiles in several versions. A prototype is scheduled to be flying in mid-1991. "Barracuda First Flight by 1991," Jane's Defence Weekly 11, no. 26 (1 July 1989): 1372.

[74] "Astros II," Defense & Armament Heracles International, June 1988, 79.

II artillery systems to Iraq.[75] In a $200 million contract, India reportedly has become the first country outside of the Persian Gulf to purchase the Astros II, and will adopt the system as standard equipment for its Army.[76]

Avibrás is now developing a series of ballistic missiles. The SS-150, with a range of 150 kilometers, was projected to be operational by 1987, but may only be available in the early 1990s. The SS-300, perhaps the most important ballistic missile being developed in Brazil, is based on the solid-fuel Sonda IV rocket, with an indigenously-designed inertial guidance system. It will have a range of 300 kilometers (185 miles), and will be capable of carrying a 1,000 kilogram (2,200 pound) warhead. The SS-300 missile would be purchased by the Brazilian Army, but its major market is likely to be the Middle East. Libya and Iraq have already expressed interest in the SS-300. A full-scale prototype of the SS-300 has already been completed, but it will not be operational until the late-1990s.[77]

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[75] Michael Brzoska and Thomas Ohlson, Arms Transfers to the Third World, 1971-85 (New York: SIPRI/Oxford University Press, 1987): Appendix I, 191.

[76] "India, Iraq to Purchase Artillery System," (in Portuguese), O Globo, 24 May 1989, 26, translated and reported in FBIS LAT-89-101, 26 May 1989, 39.

[77] CRS Report, 89-90.

Some mention has been made of an SS-1000, based on the Sonda rocket and with a range of 1,200 kilometers (740 miles). The SS-1000, to be designed by the CTA, has yet to be funded. If research and development funds were made available and the production were effected, the project would be controversial, because its expanded payload capability would enable it to carry a nuclear warhead. If developed and later sold, such a missile in the hands of the Libyans or Iraqis could have serious implications for Israeli, U.S., and North Atlantic Treaty Organization interests in the region. Furthermore, the SS-1000 could reach any target in South America from Brazil. No timetable has been officially set for the SS-1000, but even if a political decision were made to produce the missile, it is unlikely that it would become available prior to the turn of the century.[78]

All Avibrás programs were "put on hold" in January 1990, when the company filed for bankruptcy. Its employee roster had fallen from 6,000 to 900, and the company had $90 million worth of unsold rockets - largely a result of the end of the Gulf War.[79] The bankruptcy underscored the vulnerability of Brazil's arms industry and its potential ballistic missile program.

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[78] Jack Anderson, "Brazilian Missiles," The Herald (Monterey), 28 March 1988, 18.

[79] James Brooke, "Peace Unhealthy for Brazilian Arms Industry," The New York Times, 26 February 1990, A4.

b) Órbita

In the mid-1980s, Brazil's armed forces became frustrated by delays in the development of self-guided missiles. Following the June 1986 meeting between private industry and the military, a consensus was reached that standardization was necessary in missile production.[80] As a result, a new firm, Órbita Sistemas Aerospaciais S.A., was created in February 1987 to coordinate Brazil's missile program. It is owned by Engesa (Engenheiros Especializados S.A. - 40 percent), Embraer (Empresa Brasileira de Aeronáutica S.A. - 40 percent), Esca (Engenharia de Sistemas de Controle de Automação S.A. - 11 percent), Imbel (Indústria de Material Bélico do Brasil - 5 percent), and Parcom (Participações e Consultcria - 4 percent). órbita was tasked with developing guided missiles as well as rockets and satellite launchers for civilian applications.[81]

Órbita inherited the MB/EE-150 project from Engemissil, a subsidiary of Engesa. As a result of Órbita's financial

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[80] "Programa brasileiro de mísseis será unificado," O Globo, 2 June 1986; "Latin America: Centralizing Brazil's Missile Production," Defense & Foreign Affairs Weekly 12, no. 22 (22 June 1986): 2-3.

[81] "Brazil Founds Launch Company," Satellite News, 2 March 1987, 3.

constraints, the MB/EE-150 has not been developed, nor is it under active research and development at this point.[82] The MB/EE-150 was to have been only the first in a series of missiles, including the MB/EE-350 (with a 350 kilometer range), the MB/EE-600 (600 kilometers), and the MB/EE-1000 (1,000 kilometers) - all based on the Sonda series of experimental rockets.[83]

Órbita is also developing two new missiles: the MSS-1 Leo, an anti-tank missile developed with Italy's OTO Melara, and the MSA-1, an anti-tank missile of shorter range than the Leo.[84] The company has been modernizing the Seacat shipborne surface-to-air missiles, purchased from Great Britain in the mid-1970s.[85] These projects, however, have been seriously hampered by a severe shortage of funds, and by Engesa's precarious financial condition.

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[82] The Congressional Research Service describes the MB/EE-150 in its projected form as "a mobile tactical missile, fired from a dual-launcher chassis, and capable of carrying a 1,100 pound (500 kilogram) warhead to a range of 90 miles (150 kilometers). It will have inertial guidance, and some reports say it will also have terminal homing guidance that will allow it to be directed to a target with great accuracy." CRS Report, 89. For further description of the MB/EE-150, see "Brazilian Defense: Full Speed Ahead," Defense & Foreign Affairs 15, no. 3 (March 1987): 33-35.

[83] CRS Report, 89.

[84] "Nouveaux missiles francaises et etrangers: 3 nouveaux missiles bresiliens," Air et Cosmos 1149 (27 June 1987): 82.

[85] "Navy Planning to Upgrade Seacat Missile," (in Portuguese), O Estado de São Paulo, 9 September 1988, 5, translated and reported in FBIS LAT-88-176, 12 September 1988, 35.

A third missile, the Mol, had its funding reduced in mid-1988,[86] and was eventually cancelled in August 1989 because of budget constraints. The Mol was initially projected in the late 1970s. The CTA was responsible for its development until 1986, when it was handed over to Engesa. In 1987, Órbita was given control over the missile. The Mol would have been an air-to-air missile designed for the F-5E of the Brazilian Air Force and the AMX subsonic fighter (co-produced with Italian firms), and would have competed with the Sidewinder (U.S.A.) and Magic (France) on the international market. The cancellation of the Mol is significant because of the high priority the missile had been accorded by the Brazilian Air Force. Now Brazil will purchase air-to-air missiles from either France, the United States, England, Italy, Czechoslovakia, Israel, or the Soviet Union.[66]

Today Órbita is virtually defunct, with no manufacturing, products, or sales, and little, if any actual research and development. It is all but a shell of an organization that has

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[86] Roberto Lopes, "Ministry Cuts Money for Air-to-Air Missile," (in Portuguese), Folha de São Paulo, 1 July 1988, A-4, translated and reported in FBIS LAT-88-128, 5 July 1988, 26.

[66] Joaquim Monteiro, "Lacking Funds, Air Force Retires Piranha," (in Portuguese), Correio Braziliense, 6 August 1989, 16, translated and reported in FBIS LAT-89-191, 4 October 1989, 37. The Mol became a victim of budget cuts as early as 1988, when the Air Force was denied the $25 million requested for the project. See "Piranha Missile Programme Loses Government Funding," African Defence Journal 96 (August 1988): 45.

generated substantial press in an attempt to obtain funding for research and development. Its survival may depend on Engesa's financial resurrection. While Órbita may indeed be "Brazil's NASA" (National Aeronautics and Space Administration) of the future, it is Avibrás that will continue to lead Brazil's ballistic missile program into the coming century, assuming that Avibrás can survive its current crisis.

D. Problems Facing Brazil's Missile Program

Brazil is facing a number of pressures in the development of its space and ballistic missile programs. They are related to (1) technological constraints; (2) U.S. restrictions; and (3) inadequate funding. Any one of the problems would be serious; the combination of the three has nearly crippled Brazil's space and ballistic missile ventures.

1. Technological Constraints

The complexities involved in a ballistic missile capability are staggering. For example, Brazil's satellite launch vehicle is a four-stage rocket with seven engines, 70,000 different components, and 8,000 meters of electrical wiring. At launch it

stands 18.8 meters tall, and weighs 50 tons.[67] Given such technological intricacies, what is it that Brazil needs to further develop its space and missile programs?

The list of bottlenecks in Brazil's missile program is long, and includes technology that is related to at least the following categories: re-entry vehicles, fuel components, stage separation devices, telemetry, and stabilizing and roll systems. Early tests of the Sonda IV rocket were plagued by failures in stage separation. In the long run, the most important bottleneck is likely to be guidance systems.

A related problem is that of questionable technological choices made by Brazil. Some technicians who previously worked at the IAE have complained about "technical errors" in their project. One error cited was that of the configuration of the first stage of the rocket, which consisted of four engines, thereby requiring a volume of steel three times larger than would have been necessary for a single, more powerful engine. The additional steel means that the first stage weighs considerably more, and requires added fuel - all of which pose greater

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[67] Jane's Spaceflight Directory, 1988-89 (Alexandria, Virginia: Jane's Information Group Inc., 1988): 432; Andrew Wilson, editor, Interavia Space Directory, 1989-90, previously Jane's Spaceflight Directory (Alexandria, Virginia, Jane's Information Group, 1989): 310; "Obstacles to VLS Development Reviewed," (in Portuguese), Folha de São Paulo, 14 July 1989, G-3, translated and reported in FBIS LAT-89-156, 15 August 1989, 29.

difficulties in engineering design.[68] A second error cited by the technicians is the use of solid fuel instead of liquid fuel, which is generally considered more effective for ballistic missiles.[69]

2. U.S. Restrictions

Closely related to Brazil's technological bottlenecks is the fact that its traditional supplier, the United States, has restricted most of the requested technology for the space and missile programs, since the signing of the MTCR in 1987. The impact of such denials was immediate and severe. Captain Clifford P. Graham describes some of the initial restrictions:

> Particularly hard hit were CTA's requests for technical assistance related to the SONDA rocket program. A 1987 Brazilian request for wind tunnel specifications, submitted under the CTA-USAF [U.S. Air Force] data exchange agreement, was denied by the U.S. due to MTCR constraints. Simultaneously at the national level, the U.S. Department of State denied a Brazilian request for the purchase of two MIDAS platforms like those already acquired for the October launch of the SONDA IV.

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[68] A related problem is one of industrial capabilities. Brazil lacks the facilities to build turbines over one meter in depth.

[69] "Obstacles to VLS Development Reviewed," Folha de São Paulo, 14 July 1989, G-3, translated and reported in FBIS LAT-89-156, 15 August 1989, 30. It could be argued that the use of solid fuels is not an error. According to the CRS Report (page 15), "Solid fuels are safer and easier to handle than liquid fuel but contain less energy per pound of propellant. It is also more difficult to control the rate and pattern of combustion of solid fuels....Liquid propellants generally offer greater thrust per pound of combustibles than solid propellants. But some liquid propellants are very corrosive and unstable."

> Shortly thereafter, Brazilian telemetry equipment which had been purchased in the United States prior to the MTCR, was seized and held for over a year by the U.S. Government when the Brazilians returned it to Ft. Lauderdale, Florida, for repair by the manufacturer."[70]

In addition, while the United States previously supplied technology related to guidance (through Space Vector, of California), it would do so no longer. The United States also denied all requests for technology related to re-entry vehicles, fuel components and stage separation devices.[71]

The following examples illustrate the problems created for Brazil by such denials, and the subsequent attempt to gain such technology from other suppliers:

> (1) A launch of Brazil's Sonda IV rocket, scheduled for 16 December 1988, was postponed because of problems with the inertial navigation system, which was originally purchased from Space Vector in the United States. The U.S. government prohibited Space Vector *from repairing* the navigation equipment; as a result, Brazil turned to Ferranti, of Britain.[72]
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> (2) The U.S. embargo of components for the inertial platform slowed the CTA's efforts to develop the VLS.

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[70] Graham, "The Brazilian Space Program and U.S. Foreign Policy Challenges," West Point, New York (United States Military Academy, Department of Geography); October 1989; unpublished report, 15.

[71] Rik Turner, "Brazil Says Missile Technology Controls Hamper Launch Industry," Defense News 4, no. 30 (July 24, 1989): 18.

[72] Roberto Lopes, "Ministry Announces Sonda-4 Rocket Launch Delay," (in Portuguese), Folha de São Paulo, 24 November 1988, C-6, translated and reported in FBIS LAT-88-229, 29 November 1988, 30.

> Eventually, the CTA found "other suppliers."[73]
>
> (3) The Air Force Ministry reported that because of U.S. restrictions on technology related to altitude guidance and the control of rockets, it would seek out the PRC and the Soviet Union.[74]
>
> (4) The United States turned down a Brazilian contract offered to Honeywell for guidance systems. Barbosa, the head of INPE, claimed that the IAE would seek to gain such technology from "other sources, like China."[75]

There is no doubt that U.S. restrictions on the export of components necessary for the development of Brazil's VLS have harmed both Brazil's satellite launch program as well as its potential, though undeclared ballistic missile program. In August 1989 the Folha de São Paulo summarized the impact of U.S. restrictions on VLS technology:

> The U.S. boycott has been so intense that even nonsensitive equipment for aeronautical use has been denied IAE. But what has been most detrimental to the development of the VLS is the ban on electronic components for control of the vehicle and engineering services. In the area of propulsion for the rocket, which will use solid fuel, the boycott has not had such a serious effect. Developing the components that are lacking in the country will take time and have a high cost.[76]

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[73] Eustaquio de Freitas, "Tactical Missile Development Reported," (in Portuguese), O Globo 3 January 1988, 7, translated and reported in FBIS LAT-88-002, 5 January 1988, 21-22.

[74] Ibid.

[75] "INSCOM: Brazil's Chinese Connection," Interavia Space Markets 5, no. 3 (August 1989): 191.

[76] "Obstacles to VLS Development Reviewed," (in Portuguese), Folha de São Paulo, 14 July 1989, G-3, translated and reported in FBIS LAT-89-156, 15 August 1989, 29.

The timing of U.S. denials of space technology to Brazil was very important, for they came at a particularly critical moment in the development of Brazil's VLS. Colonel Antonio Carlos Pedrosa, director of the IAE, estimated in November 1988 that the U.S. restrictions on VLS technology had cost Brazil $8.4 million. According to Pedrosa, the U.S. government denied three requests made by U.S. suppliers for exports to Brazil, forcing Brazil to turn to European suppliers and increasing the cost from $6 million to $14.4 million. The U.S. denials not only increased the cost of VLS development, but they also delayed the first launch of the VLS for at least two years. At the time of Pedrosa's statement (November 1988), Brazil was still awaiting the approval, by European governments, of the requested components.[77]

3. Inadequate funding

Brazil, the developing world's largest debtor with an external debt of over $110 billion, and an annual (1989) inflation rate of 1,765 percent, faces severe economic and

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[77] Mauro Malin, "U.S. Policy Hinders Satellite Program," (in Portuguese), Jornal do Brasil, 6 November 1988, 12, translated and reported in FBIS LAT-88-217 (Annex), 9 November 1988, 2-3.

financial crises.[78] Budget constraints have hindered the aerospace program considerably, despite the privileged status of the space sector.[79] The cost of INPE's four satellites was initially projected at $900 million, but INPE has received only 40 percent of those funds.[80] Of the $600 million scheduled to be disbursed to the IAE for the manufacture of the VLS by 1989 (as stipulated 10 years earlier by COBAE), the agency received only $170 million through July 1989. It is estimated that Brazil will need to spend another $170 million prior to the first launch of the VLS.[81] It is also estimated that Brazil must invest $2 billion over the 1990s to establish an indigenous satellite communications system.[82]

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[78] Thomas Kamm, "Daily Inflation Struggle Obsesses Brazil," The Wall Street Journal, 29 January 1990, A12. For a review of political and economic events in Brazil in 1989, see Riordan Roett and Scott D. Tollefson, "The Year of Elections in Brazil," Current History 89, no. 543 (January 1990): 25-29, 42.

[79] One of the few projects to escape the budget axe was that of remote sensoring. "Experts Discuss Remote Sensoring Programs," (in Portuguese), Brasília RDB, 12 October 1988, translated and reported in FBIS LAT-88-199, 14 October 1988, 3.

[80] A separate estimate, by the Jornal do Brasil, places the cost (to date) of the first generation of Brazil's satellites at $300 million. This includes the construction of the launching installation system, maintenance, insurance on equipment, etc. "Embratel Studies Bids for New Satellites," (in Portuguese), Jornal do Brasil, 26 March 1989, 34, translated and reported in FBIS LAT-89-058 (Annex), 28 March 1989, 12.

[81] "Brazil Says Missile Technology Controls Hamper Launch Industry," Defense News 4, no. 30 (July 24, 1989): 18.

[82] "Brazil to Develop Satcom System," Defense Daily 164, no. 36 (22 August 1989): 291.

In January 1989, as part of a broader economic adjustment program dubbed "the Summer Plan," the VLS budget was cut by 55 percent. The chief of the VLS program, engineer Jayme Boscov, claims that current funds only guarantee the agency's "vegetative existence." Brazil has been forced to suspend contracts with foreigners (especially France) and to cut back on the contracting of engineering services.[83] Furthermore, many highly specialized researchers and technicians working on the missile program at CTA have left for better-paying jobs in private industry.[84]

Conclusion

In effect, Brazil occupies a third tier of ballistic missile producers. Its missile capabilities are modest in comparison to those of the superpowers and most major powers, but sophisticated in relation to those of most developing nations. The CRS provides a tentative assessment of Brazil's capabilities:

It appears likely that short-range systems are probably

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[83] "Obstacles to VLS Development Reviewed," (in Portuguese), Folha de São Paulo, 14 July 1989, G-3, translated and reported in FBIS LAT-89-156, 15 August 1989, 29. See also "Sonda IV Missile to be Test Fired on 15 April," (in Portuguese), 2 April 1989, 36, translated and reported in FBIS LAT-89-071, 14 April 1989, 38.

[84] Boscov and Aviator Lieutenant Colonel Tiago da Silva Ribeiro estimated that over 150 of CTA's 4,000 employees left between 1987 and 1989. About half of these were "highly specialized." See "Obstacles to VLS Development Reviewed," (in Portuguese), Folha de São Paulo, 14 July 1989, G-3, translated and reported in FBIS LAT-89-156, 15 August 1989, 30. See also "Baixos salários levam à evasão de especialistas," Folha de São Paulo, 8 October 1987.

> in an advanced stage of development but have not been put into production. The development and testing of longer-range missiles is probably constrained by the lack of key foreign-made components and perhaps by insufficient testing of short-range systems on which the bigger missiles will be based.[85]

In sum, Brazil's ballistic missile program, facing formidable constraints, is largely in the pre-planning stages and not under serious research and development. It seems that Brazil's long-term potential for developing ballistic missiles is greater than that suggested by current capabilities, which are severely limited.

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[85] CRS Report, 88.

IV. BRAZIL'S RESPONSE: SEEKING ALTERNATIVE SUPPLIERS

Brazil's movement away from the United States in the realm of space and ballistic missile technology is part of a consistent and broad redefinition of Brazil's foreign policy that began as early as 1967 with the emergence of the hard-line and ultranationalist wing of Brazil's military under President (General) Artur Costa e Silva. That movement away from the United States culminated in the mid-1970s with the German nuclear accord and Brazil's abrogation of the military assistance agreement with the United States. In addition to a reorientation of relations with the United States, that redefinition included an approximation with the Third World and a search for ideological neutrality.[86]

Much of the tension in U.S.-Brazilian security relations stems from conflicting notions of national security. Whereas the United States has emphasized security concerns in a primarily military vein, Brazil is driven by a broader definition of security, one that includes the notion of self-sufficiency, which

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[86] For a broader discussion of Brazil's foreign policy, see Riordan Roett and Scott D. Tollefson, "Brazil's Status as an Intermediate Power," Third World Affairs 1986: 101-112.

includes technological and economic factors.[87] The conflicting definitions of national security reflect different positions within the international system. The United States, as a superpower and leader of the Western alliance, is concerned about global implications of missile proliferation. In contrast, Brazil, as a developing state and "free rider" in search of major power status, seeks to take advantage of commercial and technological opportunities to develop satellite launches and a possible ballistic missile capability.

Brazilian authorities have strongly criticized the strict implementation of MTCR guidelines by the United States.[88] For example, the chief of the VLS program, engineer Jayme Boscov, complained: "The fact is that the U.S. doesn't want to see Brazil make technical progress in space."[89] As a result of this view, the issue of U.S. restrictions of space technology to Brazil has become a greater irritant in U.S.-Brazilian relations than the nuclear issue, which has been absorbed by policy-makers in both countries, who have come to accept the fact that neither Brazil

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[87] There is evidence that this may be changing, and the United States may be moving closer to Brazil on this dimension. Currently there is a debate in the United States over the extent of U.S. military equipment being manufactured overseas, which some argue threatens self-sufficiency.

[88] "Brazil Fumes at Washington's Refusal to Allow Export of Certain Technology," The Wall Street Journal, 27 April 1989.

[89] "Obstacles to VLS Development Reviewed," (in Portuguese), Folha de São Paulo, 14 July 1989, page G-3, translated and reported in FBIS LAT-89-156, 15 August 1989, 28.

nor the United States will easily budge on the nuclear issue.

Given the U.S. restrictions on MTCR-related technology, what are Brazil's options? First, Brazil could choose to "go it alone." Brazil has shown that it is capable of designing and producing sophisticated weapon systems, such as the Astros II. Brazil's long-term goal is self-sufficiency, but it will be required to seek technology from abroad, given the technological complexities of producing rockets or ballistic missiles. The costs of "going it alone" are simply overwhelming, in light of budgetary constraints. This suggests that complete autonomy in rocket or missile technology is an impractical, if not impossible goal for Brazil.

Second, Brazil could choose to restore a close relationship with the United States in the area of space and missile technology. Indeed, many Brazilian officials continue to prefer U.S. space and missile technology. Some Brazilian scientists involved with the space program have studied in the United States, and are familiar with its techniques; they too are frustrated by having been denied the space technology.[90] The

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[90] Pedrosa lamented that "Behind the U.S. veto lies a technological dispute, and not even over advanced technology. The United States refuses to transfer 20-year-old technology, [and] even this causes us great harm." Mauro Malin, "U.S. Policy Hinders Satellite Program," (in Portuguese), Jornal do Brasil, 6 November 1988, 12, translated and reported in FBIS LAT-88-217 (Annex), 9 November 1988, 2-3.

minimum U.S. preconditions for such a restoration in technology transfers would be the signing of agreements that preclude the re-transfer of such technology without U.S. approval. Brazil has shown that it is unwilling to limit its autonomy in this manner. Citing sovereignty concerns, Brazil has not allowed for international supervision of its nuclear program, and it is unlikely that it would agree to similar oversight of its space rocket programs. Under the new president, Fernando Collor de Mello, this may change. President Collor de Mello has suggested that Brazil may sign the NPT, as part of a broader internationalist developmental model.

Brazil's third and most promising option is that of seeking diversified suppliers of technology and financing. Some, especially within the Ministry of Foreign Relations (Itamaraty), see this as a major opportunity for Brazil to break its dependence on the United States in such a sensitive area, and to strengthen ties with other suppliers. Given the lack of international consensus on the diffusion of ballistic missile technology, Brazil can take advantage of multiple suppliers of space and missile technology without excluding the United States as a source. The following section discusses some of the leading supplier alternatives for Brazil.

A. MTCR Signatories

Brazil's most promising alternative suppliers of space and missile technology are among the MTCR members, especially France. Brazil also cooperates on space matters with the FRG, the United Kingdom, and Canada, but has yet to establish such links with Italy and Japan.[91] Outside of the MTCR community, Brazil has pursued space technology ventures with the PRC, the Soviet Union, Iraq, Libya, and to a minor extent with Sweden and Switzerland.

1. France

France has emerged as Brazil's major alternative to the United States in supplying space technology to Brazil. This parallels the French position as Brazil's largest supplier of major conventional weapons from 1981-1985 [see Table 2]. In August 1989 the Folha de São Paulo reported that in contrast to the Americans, with their restrictions on the transfer of missile

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[91] It should be noted, however, that Brazil (via Embraer) has cooperated closely with Italy in the development and construction of the AMX subsonic fighter, and in purchasing missiles for the AMX. Brazil also cooperates with the European Space Agency (ESA) in tracking ESA rockets fired from Kourou, in French Guiana. The ESA is a consortium of nine countries, in which France (65 percent) and the FRG (25 percent) are the largest shareholders. Brazil charges $100,000 for each tracking. See Vinicius Doria, "Alcântara Site of a New Rocket Launching Center," (in Portuguese), Brasília EBN, 27 May 1988, translated and reported in FBIS LAT-88-109A, 7 June 1988, 2.

technology, "the French have not been so inflexible. Space cooperation with France is by now traditional."[92]

[92] "Obstacles to VLS Development Reviewed," (in Portuguese), Folha de São Paulo, 14 July 1989, G-3, translated and reported in FBIS LAT-89-156, 15 August 1989, 29.

TABLE 2

Shares of Major Suppliers in Brazil's Imports of Major Conventional Weapons, 1951-1985

	Supplier							
Period	USA	France	UK	FRG	Italy	Third World	Other*	Total in 1985 US $m.
1951-55	83	-	17	-	-	-	-	405
1956-69	68	5	25	-	-	-	2	600
1961-65	92	1	5	-	-	-	2	496
1966-70	58	1	12	-	-	-	29	473
1971-75	76	6	9	3	7	-	0	1,996
1976-80	27	7	62	0	4	-	1	2,547
1981-85	14	36	-	0	35	9	6	178

*Does not include the Soviet Union or the People's Republic of China, neither of which has supplied Brazil with any major weapons

Source: Michael Brzoska and Thomas Ohlson, Arms Transfers to the Third World, 1971-85 (New York: SIPRI/Oxford University Press, 1987): Appendix 7, 340.

Brazil is negotiating with France to receive the Viking liquid-fuel rocket engine technology. The Viking engine is the first stage of Europe's Ariane launcher. The United States has protested the sale, arguing that it violates the MTCR, and that such technology could eventually reach radicals or terrorist nations via Brazil.[93]

Other examples of space cooperation with France include Brazil's purchase of guidance systems from SAGEM.[94] France is also providing expertise and technical assistance for building the Alcântara launch site.[95] In addition, the Brazilian base at Barreira do Inferno tracks the French Ariane rockets launched from Kourou, in French Guiana.[96]

France made a bid to launch two Brazilian telecommunications satellites (Brasilsat B) on its Ariane 4 rocket. Under the $210 million contract, France reportedly proposed to transfer

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[93] "Government Negotiating to Buy Ariane Engine," (in French), Paris Domestic Service, 17 July 1989, translated and reported in FBIS LAT-89-140, 24 July 1989, 49.

[94] CRS Report, 93.

[95] "Le Bresil prevoit de lancer ses 4 premiers satellites en 1989-99," Air et Cosmos 1147 (13 June 1987): 197, 199; "Brazil Founds Launch Company," Satellite News, 2 March 1987, 3; Gilbert Sedon, "France-Brazil Space Deal Attacked," Flight International, 12 August 1989, 17.

[96] "Center Announces Successful Tracking of Ariane," (in Portuguese), Brasilia EBN, 15 June 1988, translated and reported in FBIS LAT-88-118 (Annex), 20 June 1988, 1.

sensitive rocket motor technology in an offset arrangement. The U.S. company competing for the contract was McDonnell Douglas (Delta 2 rocket), which turned to the U.S. government for support. McDonnell Douglas claimed that because of France's more liberal export policy, the company was at a disadvantage in the competition.[97]

Indeed, many U.S. policy-makers are frustrated with France's more liberal transfer of space technology to Brazil. The United States has exerted, with some success, diplomatic pressure on France in order to restrict the transfer of such technology. Nonetheless, U.S. policy-makers grudgingly admit that France is a logical source of space technology for Brazil.

There are, however, limits to what France will transfer to Brazil. The Viking liquid-fuel rocket engine technology mentioned above is over 20 years old, and pales in comparison to some of the newer technology that Brazil would like to receive from the United States. Concerned with Brazilian arms exports to Libya, the French have openly criticized Brazil's export policy. Jacques Boyon, French secretary of state to the minister of defense, warned in a visit to Brasília that the sale of ballistic missiles has grave implications for the exporter, and cited his

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[97] "Brazilian Satellites," Aviation Week & Space Technology, 21 August 1989, 15; "McDonnell Douglas, Hughes Battling for Brazilsat 2 Deal," Space Commerce Bulletin, 28 July 1989, 2-4.

country's policy of requiring end-use certification in transferring such technology.[98]

2. The Federal Republic of Germany

Some U.S. policy-makers claim that the FRG is even more liberal than France in transferring Category II items. The FRG has been extensively involved in Brazil's nuclear program, but has not participated as broadly as France in Brazil's space program. It has helped Brazilian engineers develop rockets that provide the basis for the development of a future launcher.[99] Germany has also utilized *Barreira do Inferno* to launch experimental rockets. Germany is constrained, though, in that it too must buy launching services from others,[100] and because of its history of closer collaboration with Argentina, Brazil's traditional rival.

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[98] "French Defense Secretary Meets Officials," (in Portuguese), Brasilia EBN, 8 March 1988, translated and reported in FBIS LAT-88-047 (Annex), 10 March 1988, 1.

[99] "Brazil Founds Launch Company," Satellite News, 2 March 1987, 3.

[100] "FRG to Cooperate in Rocket Launching," (in Portuguese), Brasilia Domestic Service, 8 August 1988, translated and reported in FBIS LAT-88-153, 9 August 1988, 32; "Skylark Rocket Successfully Launched 4 Sep," (in Portuguese), Jornal do Brasil, 4 September 1988, 17, translated and reported in FBIS LAT-88-175, 3.

3. United Kingdom

Britain's participation in Brazil's missile program has been extremely limited. British Aerospace has assisted Órbita in the production and launching of a land-to-air high-velocity missile. These shoulder-fired missiles are targeted for low-flying aircraft and helicopters.[101] The U.K. has been more restrictive than France or the FRG in interpreting the MTCR, and it is unlikely that the U.K. will increase significantly its ties with Brazil in this sensitive area.

4. Canada

Canada has been a major participant in the Sistema Brasileiro de Telecomunicações para Satélite (SBTS - Brazilian System of Satellite Telecommunications), the first domestic satellite system in Latin America. Under license from Canada's Spar Aerospace, Brazil built the Brasilsat 1 (launched 8 February 1985) and Brasilsat 2 (launched 28 March 1986), which are fully operational.[102] Currently, Spar is bidding against Hughes (United States) for the follow-on contract for a new generation of

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[101] "Brazilian MSAAV High Velocity Missile Developed," African Defence Journal 89 (January 1988): 33.

[102] For a description of the Brasilsat program, see Jane's Spaceflight Directory, 1988-89 (Alexandria, Virginia: Jane's Information Group Inc., 1988): 631.

satellites, dubbed Brasilsat B.[103] Canada's role in Brazil's space program has been primarily limited to satellites, and it is unlikely that Canada will become a major player in the development of Brazil's VLS or ballistic missile program.

B. MTCR Non-Signatories

1. People's Republic of China

Brazilian officials have shown a certain fascination with "pursuing the China option."[104] The PRC offers liquid-fuel technology, a proven launch capability, and expertise in rocket or missile guidance systems. In turn, Brazil presents solid-fuel technology,[105] an equatorial launch site,[106] abundant natural

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[103] "Spar Aerospace Outbids Hughes for Brazilsat Replacement," Satellite News, 10 April 1989, 7; "Brazilian Satellites," Aviation Week & Space Technology, 21 August 1989, 15; "Embratel Studies Bids for New Satellites," (in Portuguese), Jornal do Brasil, 26 March 1989, 34, translated and reported in FBIS LAT-89-058 (Annex), 28 March 1989, 12.

[104] See, for example, "Sarney Comments on Meeting with PRC's Li Peng," (in Portuguese), Brasilia EBN, 4 July 1988, translated and reported in FBIS LAT-88-131, 8 July 1988, 1.

[105] Aeronautics Minister Moreira Lima has stated that Brazil and the PRC are studying an exchange that would involve the transfer of liquid propellants to Brazil. "Air Force Chief Comments on Objectives," (in Portuguese), O Estado de São Paulo, 6 April 1989, 17, translated and reported in FBIS LAT-89-067, 10 April 1989, 36.

[106] CRS Report, 93.

resources, computers,[107] and conventional weapons. As early as 1985, Brazil sought PRC technology for satellite launches.[108] Brazil and the PRC signed a nuclear agreement in 1984, but it was never implemented.[109] They signed a second nuclear accord on 14 January 1988, for industrial cooperation in developing reactors and other nuclear projects,[110] under IAEA supervision.[111]

When it became evident that the MTCR restrictions on space technology would delay the launch of Brazil's VLS, the PRC became an even more attractive alternative.[112] Marco Antonio Raupp, for example, claimed that with Chinese assistance in rocketry, Brazil could put into orbit satellites that could compete internationally with the Landsat (United States) and Spot

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[107] "PRC Interested in Informatics Cooperation," (in Portuguese), O Globo, 3 November 1988, 25, translated and reported in FBIS LAT-88-233, 5 December 1988, 49.

[108] Brazil also showed an interest in purchasing the Y-7 two-engine troop transport plane. "Air Force Interested in Purchasing PRC Planes," (in Portuguese), Brasília EBN, 28 June 1988, translated and reported in FBIS LAT-88-124 (Annex), 28 June 1988, 1.

[109] "Foreign Minister on PRC Nuclear Policy," (in Portuguese), O Globo, 7 July 1988, 6, translated and reported in FBIS LAT-88-133, 12 July 1988, 21-22.

[110] "Scientists Skeptical About PRC Nuclear Accord," (in Portuguese), Brasília Domestic Service, 19 January 1988, 25, translated and reported in FBIS LAT-88-017, 27 January 1988, 25.

[111] "IAEA to Supervise Nuclear Accord with PRC," (in Spanish), Madrid EFE, 16 January 1988, translated and reported in FBIS LAT-88-012, 20 January 1988, 35.

[112] Stéphane Chenard, "INSCOM: Brazil's Chinese Connection," Interavia Space Markets 5, no. 3 (August 1989): 191.

(France).[113] In July 1988, President Sarney and a high-profile entourage[114] visited the PRC and signed eight governmental treaties, in an attempt to expand trade,[115] military links,[116] and technical cooperation with the PRC.[117] According to Brazil's Minister of Foreign Relations Abreu Sodré, the most important of the treaties signed in July 1988 was the agreement on the

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[113] "O espaço deve ser civil," (Interview with Marco Antonio Raupp), Veja, 8 February 1989, 5-8. A separate and unconfirmed report claimed that Brazil and China will develop an earth imaging satellite, to be launched on a Long March booster in 1992. Brazil will contribute $85 million, of which $45 million has already been approved. Brazil will be able to utilize 30 percent of the satellite's services. "China, Brazil to Develop Earth Imaging Satellite," Aviation Week & Space Technology, 7 March 1988, 29.

[114] The group included Foreign Minister Roberto de Abreu Sodré, Air Force Minister Octávio Moreira Lima, Military Household Chief General Rubens Bayma Denys, Irrigation Minister Vicente Fialho, Agrarian Reform Minister Jader Barbalho, Science and Technology Minister Luiz Henrique da Silveira, and six congressmen. "Sarney, Entourage to Leave for PRC on 30 June," (in Portuguese), Brasília Radio Nacional da Amazonia Network, 28 June 1988, translated and reported in FBIS LAT-88-125, 29 June 1988, 21.

[115] Trade with the PRC had fallen from $1.2 billion in 1985 to $620 million in 1987. "Foreign Minister Comments on Trade with PRC," (in Spanish), Madrid EFE, 3 July 1988, translated and reported in FBIS LAT-88-128, 25.

[116] For example, Brazil assigned a military attaché to China, in hopes of strengthening ties between the two countries. "Abreu Sodré Comments on Upcoming Trip to PRC," (in Portuguese), Brasília EBN, 23 April 1988, translated and reported in FBIS LAT-88-083, 29 April 1988, 5-6; "Foreign Minister: PRC Trip Results 'Positive'," (in Portuguese), Brasília Domestic Service, 9 May 1988, translated and reported in FBIS LAT-88-090, 10 May 1988, 24. In addition, Brazil explored the possibility of jointly producing "defensive weapons" with the PRC. "Foreign Minister Comments on Trade with PRC," (in Spanish), Madrid EFE, 3 July 1988, translated and reported in FBIS LAT-88-128, 5 July 1988, 25.

[117] "Sarney Returns from Official Visit to PRC," (in Portuguese), EBN, 10 July 1988, translated and reported in FBIS LAT-88-134, 13 July 1988, 4.

construction and launching of two satellites to explore natural resources.[118]

The Chinese contract was mired in controversy in Brazil. INPE pressed for an early test of its satellite and favored a foreign (including Chinese) launch. The IAE, CTA, Air Force Ministry and Armed Forces staff feared that a major contract with the PRC would reduce funds for the Sonda IV program, thereby undermining the MECB goal of self-sufficiency. The conflict was eventually settled with the participation of President Sarney, who hoped that the satellite would be placed in orbit prior to the end of his term in March 1990.[119] According to Roberto Lopes, of the Folha de São Paulo, Brazil's government "adopted a Solomonic attitude to meet both demands: It authorized an accord with the PRC, and assured the military that neither the Sonda IV nor the VLS projects would be discontinued."[120]

Under the agreement, INPE cooperates with CAST (Chinese

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[118] "Foreign Minister Comments on Trade with PRC," (in Spanish), Madrid EFE, 3 July 1988, translated and reported in FBIS LAT-88-128, 5 July 1988, 25.

[119] Mauro Malin, "U.S. Policy Hinders Satellite Program," (in Portuguese), Jornal do Brasil, 6 November 1988, 12, translated and reported in FBIS LAT-88-217 (Annex), 9 November 1988, 2-3; see also Eustaquio de Freitas, "Government Indecision Imperils Space Leadership," (in Portuguese), O Globo, 5 December 1988, 10, translated and reported in FBIS LAT 89-014, 24 January 1989, 40.

[120] "Controversial ICBM, Other Projects Viewed," (in Portuguese), Folha de São Paulo, 21 July 1988, A-24, translated and reported in FBIS LAT-88-142, 25 July 1988, 34.

Academy for Space Technology) in designing remote sensing satellites that collect information for agriculture, mineral prospecting, and cartography. Brazil funds 30 percent of the $170 million program.[121] In 1992, two data collection satellites were to be launched on the Chinese Long March 2C rocket from southern China, followed by two remote sensing satellites in 1994. President Sarney claimed that INPE was cooperating with CAST in order to "together, break the [developed countries'] monopoly of high technology."[122]

On 19 February 1989 Avibrás (30 percent) and China Great Wall Industrial Corporation (CGWIC, 70 percent) formed International Satellite Communication (Inscom) in order to sell satellites, launch vehicles, earth stations, and antennas, as

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[121] In the long term, Brazil was expected to contribute $100 million to the project, a price tag that would have been $300 million with a western country. See "Resource Satellite to be Built with PRC," (in Portuguese), O Globo, 21 December 1989, 30, translated and reported in FBIS LAT-89-247, 27 December 1989, 43.

[122] The quote is from "Brazil, PRC to Launch Satellites in 1992," (in Portuguese), Brasilia Radio Nacional da Amazonia Network, 22 April 1988, translated and reported in FBIS LAT-88-081, 27 April 1988, 36. See also Stéphane Chenard, "INSCOM: Brazil's Chinese Connection," Interavia Space Markets 5, no. 3 (August 1989): 189-191; "Details of Satellite with PRC Disclosed," (in Portuguese), Folha de São Paulo, 6 July 1988,) A-7, translated and reported in FBIS LAT-88-132, 11 July 1988, 35; "Minister on Satellite PRC to Build for Country," (in Portuguese), Brasilia Radio Nacional da Amazonia Network, 29 June 1988, translated and reported in FBIS LAT-88-126, 30 June 1988, 26-27; "Satellite Project with PRC Discussed," (in Portuguese), O Estado de São Paulo, 14 October 1988, 11, translated and reported in FBIS LAT-88-225, 22 November 1988, 33; "Plan to Build Satellite with PRC Approved," (in Portuguese), O Globo, 29 February 1988, 5, translated and reported in FBIS LAT-88-041, 2 March 1988, 24.

well as to market three versions of the Chinese Long March booster and the Brazilian VLS. In addition, Inscom will market launch facilities and services in both countries. The joint venture between Brazil and the PRC takes advantage of the complementary nature of their respective space programs. Avibrás is noted for its earth station construction, while CGWIC offers a proven launch capability. Furthermore, the PRC hopes to gain access to the Alcântara launch site.[123]

On 27 March 1989, Brazil's Elebra Eletronica and the government of the PRC signed an agreement for technological exchange leading to the construction of the Long March III satellite-launching rocket.[124] China's Precision Machinery Import and Export already builds the Long March II rocket. The agreement, which included Brazilian exports of aluminum iron, steel plates, and other products, was estimated to have been worth $2 billion.[125]

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[123] "Financial Focus: Brazil, China Enter Satellite Launch Pact," Defense News 4, no. 19 (8 May 1989): 33; "Brazil, China Form Space Launch Venture," Aviation Week & Space Technology 130, no. 22 (29 May 1989): 35; "Brazil/PRC Joint Venture," Interavia Air Letter (6 June 1989): 10; Stéphane Chenard, "INSCOM: Brazil's Chinese Connection," Interavia Space Markets 5, no. 3 (August 1989): 189-191.

[124] Roberto Lopes, "Space Vehicle Scheduled for Launch in November," (in Portuguese), Folha de São Paulo, 17 July 1988, A-30, translated and reported in FBIS LAT-88-138, 19 July 1988, 34.

[125] CRS Report, 90; Claudia Bensimon, "Agreement Signed on PRC Rocket Technology," (original in Portuguese), Jornal do Brasil, 30 March 1989, 20, translated and reported in FBIS LAT-84-062a, 3 April 1989, 4-5.

Despite the flurry of agreements signed between Brazil and the PRC in the late 1980s, there has been only limited collaboration between the two countries.[126] First, Brazil's budget cuts have hindered cooperation with the PRC. For example, the launching of the first satellite was postponed 15 months because of Brazil's delays in making its contribution of $6 million that was due in 1989.[127] Second, Brazilian technicians, trained in the West, are less than enthusiastic about Chinese technology. Third, the PRC's liquid fuel technology will render all solid fuel programs (such as Sonda) irrelevant, making it expensive to "change in mid-stream." Based primarily on technical considerations, Brazilian officials decided in 1989 against the Long March option.

Brazil is also aware that a closer relationship with the PRC could elicit negative feedback from the United States and other MTCR signatories. For the United States, Brazilian-Chinese cooperation is of greater concern than Brazilian-French collaboration, because of the PRC's non-aligned status and its recent transfer of sophisticated ballistic missiles to the Middle

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[126] For example, a team from INPE of 21 scientists and technicians went to PRC to work for two months with the PRC Academy of Space Technology, in Beijing.

[127] "Resource Satellite to be Built with PRC," (in Portuguese), O Globo, 21 December 1989, 30, translated and reported in FBIS LAT-89-247, 27 December 1989, 43.

East. Brazil's reluctance to seek closer ties with the PRC seems, though, to reflect technological and not political considerations. The Air Force Chief of Staff, Lieutenant Brigadier Cherubim Rosa Filho, when asked about Brazilian-Chinese space programs, answered flatly: "A long time ago ideology stopped being an impediment to armament deals."[128]

2. Soviet Union

Rapprochement between Brazil and the Soviet Union began in 1986 with the visit to Moscow of Foreign Minister Olavo Setúbal, which was reciprocated in 1987 by Soviet Foreign Minister Eduard Shevardnadze. In September 1988, Brigadier Cherubim Rosa Filho became the first Brazilian military officer to pay an official visit to the USSR.[129] In October 1988, President José Sarney became the first Brazilian head of state to visit the Soviet Union. His entourage included Army Minister Leônidas Pires

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[128] "Air Force Chief Comments on Objectives," (original in Portuguese), O Estado de São Paulo, 6 April 1989, 17, translated and reported in FBIS LAT-89-067, 10 April 1989, 36.

[129] Brigadier Cherubim Rosa Filho was chief of the General Air Command (COMGAR), and was accompanied by Brigadier Socrates da Costa Monteiro, deputy Air Force chief of staff. "Air Force Commanders to Tour Bases in USSR," (in Portuguese), O Globo, 19 August 1988, 6, translated and reported in FBIS LAT-88-163, 23 August 1988, 20.

Gonçalves and Navy Minister Henrique Sabóia.[130]

Prior to Sarney's trip, Brazil and the Soviet Union had limited cooperation in space and atmospheric research.[131] During the trip, the two countries signed ten documents that strengthened bilateral ties in the fields of trade, science, technology, culture, and space.[132] The space accord called for cooperation in space research, the exchange of scientists and scientific data, and the utilization of launch vehicles and launching centers.[133] More important, Minister of Science and Technology Ralph Biasi claimed that the accord opened the way for

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[130] "Army, Navy Ministers to Visit USSR with Sarney," (in Portuguese), Folha de São Paulo 25 September 1988, A-4, translated and reported in FBIS LAT-88-189, 29 September 1988, 18.

[131] For example, the Physics Institute of the Campinas State University (UNICAMP) and the Soviet Union cooperated in the launching of over 100 stratospheric balloons in 1988, in an effort to study cosmic rays. See "Scientific Cooperation Accord with USSR," (in Portuguese), Jornal do Brasil, 28 February 1988, 18, translated and reported in FBIS LAT-88-042 (Annex), 3 March 1988, 1. In a separate study, INPE, the Moscow Science Institute, and several Brazilian universities cooperated on atmospheric research. See Eustaquio de Freitas, "Joint Atmospheric Research with USSR Begins," (in Portuguese), O Globo, 3 April 1988, 8, translated and reported in FBIS LAT 88-065, 5 April 1988, 25; "Cooperation with Soviet Space Projects Planned," (in Portuguese), Folha de São Paulo, 16 March 1988, A19, translated and reported in FBIS LAT-88-053, 18 March 1988, 30.

[132] "Sarney Visit to Result in Accords with USSR," (in Portuguese), Brasília RDB, 13 October 1988, translated and reported in FBIS LAT-88-199 (Annex), 14 October 1988, 1.

[133] Dilze Teixeira, "Space Cooperation Accord Signed with USSR," (in Portuguese), Correio Braziliense, 20 October 1988, 21, translated and reported in FBIS LAT-88-218, 10 November 1988, 24-26.

the transfer of Soviet technology in the areas of guidance systems, fuels, and rocket propulsion. In return, the Soviet Union was especially interested in Brazilian technology in computers and machinery manufacture.[134] According to Biasi, the accord was "more encompassing than that signed with China at the end of August this year [1988], which is limited to the development of satellites."[135]

The signing of a space cooperation accord with the Soviet Union raised the question of its implications for Brazilian-U.S. relations and the prospect of U.S. retaliation. In three separate statements justifying the accord, Brazilian policy-makers asserted Brazil's sovereignty and growing autonomy vis-à-vis the United States:

> The national policy in this area of scientific and technological development - and this includes information systems and automation - is autonomous, and for that reason, we are free to make any accord with the Soviet Union or any other country. [Biasi]

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[134] "Soviets Interested in Computer Joint Ventures," (in Portuguese), Jornal do Brasil, 22 September 1988, 18, translated and reported in FBIS LAT-88-186 (Annex), 26 September 1988, 1; "USSR Interested in Brazilian-Made Computers," (in Portuguese), Veja, 20 April 1988, 39, translated and reported in FBIS LAT-88-078, 22 April 1988, 23; "Technology Exchange with USSR Contemplated," (in Portuguese), O Estado de São Paulo, 3 June 1988, 21, translated and reported in FBIS LAT-88-111, 9 June 1988, 32; "Soviets to Buy Brazilian Automation System," (in Portuguese), O Globo, 17 July 1989, 17, translated and reported in FBIS LAT-89-137, 19 July 1989, 59.

[135] Dilze Teixeira, "Space Cooperation Accord Signed with USSR," (in Portuguese), Correio Braziliense, 20 October 1988, 21, translated and reported in FBIS LAT-88-218, 10 November 1988, 24-26.

> There could be a retaliation by the U.S. government, but this is natural... When a country begins to grow, it threatens the space of others. What we cannot do is remain linked to the United States forever. [Minister of Foreign Relations, Abreu Sodré]
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> We are not members of any political or military bloc; therefore we are sovereign in establishing relations with whatever nation, in accordance with our interests.... Brazil is exercising the sovereign right to have complete relations with the entire world. [President José Sarney][136]

Both Sodré and Sarney stated that closer ties with the Soviet Union did not mean that Brazil was moving against the United States.

Brazilian policy-makers argue that they are seeking Soviet assistance not as a first option, but as a response to MTCR restrictions on the transfer of space and missile technology. In 1988 Brigadier Cherubim Rosa Filho stated that Brazil was seeking Soviet space technology because "the countries which claim to be our friends are not transferring technology to the Brazilian space program....if those countries refuse to supply this technology, there are new friends who will."[137] In May 1989 he reiterated his position: "We want to improve our knowledge of rocket-guidance systems and liquid fuels....If our traditional

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[136] Dilze Teixeira, "Space Cooperation Accord Signed with USSR," (in Portuguese), Correio Braziliense, 20 October 1988, 21, translated and reported in FBIS LAT-88-218, 10 November 1988, 24-26.

[137] "Officer Views Space Cooperation with USSR," (in Portuguese), Brasilia RDB, 12 September 1988, translated and reported in FBIS LAT-88-179 (Annex), 15 September 1988, 1.

partners, the United States, the United Kingdom, France, and others, refuse to transfer their space technology, we will try to obtain it from countries with different ideologies."[138]

For the Soviets, increased space cooperation with Brazil is viewed as a means to compensate for the trade imbalance with Brazil. From 1983-1987 the Soviets had a $2 billion deficit in their trade with Brazil. Furthermore, there is some evidence that the Soviets, sensing that they had lost out on a good opportunity for cooperation with Brazil, were unhappy with the earlier Brazil-PRC accord to launch two observation satellites.[139]

In fact, there has been only modest activity generated by the Brazilian-Soviet space accord. Brazil is participating in the Soviet Mars Phobos project. Brazil's National Institute of Space Research will coordinate Brazil's work in the Soviet Union,[140] and the Radio-Observatory Network will track the project's two probes. In addition, Brazil will participate with the Soviets in the Aktivny project to study the ionosphere and to

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[138] The statement was made prior to a visit by Marshal Aleksandr Nikolayevich Yefimov (commander in chief of the Soviet Air Forces and Deputy Defense Minister) to Brazil between 14-20 May 1989. "Soviet Air Force Delegation to Visit 14-20 May," (in Portuguese), Brasília RDB, 4 May 1989, translated and reported in FBIS LAT-89-088A, 9 May 1989, 10.

[139] "Soviet Official to Discuss Trade, Cooperation," (in Portuguese), Brasília EBN, 10 March 1988, translated and reported in FBIS LAT-88-052 (Annex), 17 March 1988, 1.

[140] Space Commerce Bulletin 20, no. 1 (2 January 1987): 10.

grow semiconductor crystals. In exchange, the USSR will gain access to Brazilian facilities for meteorological balloon launches.[141]

In 1989, Soviet meteorological radar and 1,300 anti-hail rockets were purchased at a cost of $2 million by Brazilian businesses with support from state and federal governments, including INPE and the ministries of the Army, Air Force, and Science and Technology. The radar, used for providing information on meteorological conditions, was installed in Lebon Regis, Santa Catarina, and the rocket launcher were installed in nine locations throughout the state.[142]

In the final analysis, U.S. policy-makers express only limited concern regarding the Brazilian-Soviet space cooperation. Indeed, there seems to be little likelihood that Brazilian-Soviet space cooperation will be enhanced significantly in the immediate future. Brazil's military is suspicious of the Soviets, and

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[141] "Brazil is Participating in Soviet Union's Mars Phobos," Space Commerce Bulletin 4, no. 5 (27 February 1987): 10.

[142] "Soviets to Install 'Unique' Meteorological Radar," (in Portuguese), Brasília RDB, 29 November 1988, translated and reported in FBIS LAT-88-234 (Annex), 6 December 1988, 6; "Soviet Meteorological Radar Taken to Site," (in Portuguese), Brasília RDB, 1 February 1989, translated and reported in FBIS LAT-89-024 (Annex), 7 February 1989, 6; "Soviet-Made Anti-Hail Rockets Installed," (in Portuguese), Brasília Radio Nacional da Amazonia Network, 26 June 1989, translated and reported in FBIS LAT-89-122, 27 June 1989, 28; "Soviet Experts to Install Weather Equipment," (in Portuguese), Brasília Radio Nacional da Amazonia, 17 July 1989, translated and reported in FBIS LAT-89-136, 18 July 1989, 55.

seems wary of developing a stronger relationship in this area.[143] Likewise, the Soviets have guarded their missile technology from most of the developing world, preferring to sell entire missile systems rather than transferring such technology. Finally, many Brazilians, such as Celso Amorim, special secretary for international affairs of the Science and Technology Ministry, have expressed dissatisfaction with the Soviet cooperation agreements. They prefer the Chinese space program because of its complementary nature, and because the Chinese are more willing to transfer their technology.[144] To a certain extent, therefore, Brazilian policy has been to pit the Soviets against the Chinese, and to "play the China card" when necessary.

It is unclear what the cataclysmic changes in the Soviet Union and the Eastern Bloc may herald for Brazilian-Soviet space cooperation. In the short term, they may hinder cooperation, as the Soviets look increasingly inward. In the long term, it is possible that a reformed Soviet Union may be looked upon with

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[143] For example, Army Minister Leônidas Pires Gonçalves and Aeronautics Minister Brigadier Moreira Lima expressed deep reservations concerning the exchange of military attachés with Moscow. Moreira Lima added that "when we have to decide between sending military attachés to the PRC or to the Soviet Union, we will choose to send them to the former country, where we have more immediate interests."

[144] Chico Mendonça, "Relations with PRC, Soviet Union Evaluated," (in Portuguese), Jornal do Brasil, 17 July 1988, 27, translated and reported in FBIS LAT-88-138 (Annex), 19 July 1988, 1.

greater confidence by Brazil's military, thereby bolstering collaborative ventures.

3. Iraq

In December 1989 Iraq shocked the intelligence community when it announced that it had test-fired a three-stage rocket capable of placing satellites in orbit. Iraq has exploited loopholes in the MTCR and rapidly gained the technology necessary to become a missile producer. Since 1984, it has participated with Argentina and Egypt in developing the Condor II, a two-stage ballistic missile capable of delivering nuclear and chemical warheads. The Condor II has a range of up to 1,240 miles - clearly within target of every major city in Israel, if fired from Iraq or Egypt. Only Saudi Arabia's CSS-2 has a longer range (1,674 miles); Israel's Jericho II has a 930-mile range.[145]

As noted above, Iraq has traditionally been Brazil's largest market for armaments exports. Iraq and Brazil may expand their relationship and jointly develop satellites, missiles, and rockets.[146] In exchange for Brazil's technology and training,

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[145] Ed Blanche, "Western Companies Help Arm Iraq," The Sunday Herald (Monterey, CA), 28 January 1990, 1B, 5B.

[146] It was reported that Brazil would export the MAA-1 Mol (or Piranha) missile to Iraq for its combat planes, but the Mol project was cancelled by Brazil in August of the subsequent year. See "Órbita to Export 'Smart' Missiles to Iraq," (in Portuguese), O

Iraq would provide much of the financing for such programs.[147] The Iraqis are especially interested in the SS-300 missile, and may be partially funding that program. According to one report, the SS-300 could be a direct copy of the Soviet SS-1 Scud B that Iraq may have supplied to Brazil.[148] In March 1989 O Globo reported that Brazil and Iraq

> may join in a wide-ranging program of scientific and technological cooperation to train Iraqi engineers and researchers, and to develop aircraft, rockets, satellites, and weapons....As of now, the most promising part of the program is the joint development of satellites and missiles....Iraq is also interested in acquiring technologies relating to rockets and missiles capable of launching satellites, and is disposed to finance part of the Brazilian Space Program in exchange for the technology.[149]

Iraq negotiated with INPE and Embraer to build military reconnaissance satellites, in a project similar to Brazil's first satellite, used for remote sensoring. For Embraer, the deal was reportedly worth $80 million, and may have represented its first attempt to directly enter the satellite business (as a major

Globo, 20 December 1988, 24, translated and reported in FBIS LAT-89-014, 39.

[147] "Avibrás Negotiates New Accord with Iraq," (in Portuguese), O Globo, 22 February 1989, 21, translated and reported in FBIS LAT-89-060, 30 March 1989, 31; "Brazil, Iraq to Develop Rockets Jointly," (in Portuguese), O Globo, 19 March 1989, 46, translated and reported in FBIS LAT-89-065, 6 April 1989, 51.

[148] "Arms Expert [Aaron Karp] Says Iraq Can Obtain Ballistic Missiles," Reuters, 15 December 1987.

[149] "Brazil, Iraq to Develop Rockets Jointly," (original in Portuguese), O Globo, 10 March 1989, p. 46; translated and reported in English in FBIS LAT-89-065, 6 April 1989, 51.

partner in Órbita, Embraer was already involved indirectly in satellites). Embraer may also have been seeking to penetrate Iraq's market, with an eye toward future sales of its Tucano trainer and AMX subsonic fighter. Itamaraty, fearing U.S. sanctions through the MTCR, denied that VLS technology would be transferred to Iraq. Embraer President Ozílio Silva, a vocal supporter of the Iraqi deal, confirmed that negotiations on the subject were moving forward, but added that "Itamaraty does not want these negotiations to appear as if they involve a rocket technology transfer, because they, in fact, do not involve one."[150]

According to the Folha de São Paulo, a contract worth $40 million is being negotiated between Brazil and Iraq. Under the contract, Brazil would sell Iraq a satellite called "Satellite-X" at INPE because of its secretive nature. Brazil won the contract over the PRC and France because it was the only bidder to offer to exchange technology. Under the contract, INPE initially will train Iraqi technicians in Brazil. Eventually, Brazil will transfer, for $50 million, the technology necessary for Iraq to

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[150] Roberto Lopes, "Itamaraty Opposes Iraqi Satellite Construction," (in Portuguese), Folha de São Paulo, 7 April 1989, G-3, translated and reported in FBIS LAT-89-067, 10 April 1989, 35-36; see also Stéphane Chenard, "INSCOM: Brazil's Chinese Connection," Interavia Space Markets 5, no. 3 (August 1989): 191.

build its own laboratories for building and testing satellites.[151]

In June 1989, Brazil offered to sell a military observation satellite to Iraq, and discussed the possibility of selling a lab for manufacturing and testing satellites.[152] In the aftermath of the Gulf War, and the cancellation of Iraqi purchases of Brazilian armaments, Brazil is more than willing to expand its relationship with Iraq. It will do so cautiously, with the awareness that such ties could provoke U.S. reprisals.

Iraq is likely to continue to be Brazil's largest market for conventional armaments, despite the 1988-1990 downturn in Iraqi demand. Iraq has expressed an interest in the licensed production of Embraer's EMB-312 Tucano.[153] In 1989 Iraq negotiated a $500 million contract to purchase Astros II multiple

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[151] "Iraq to Purchase INPE Satellite, Technology," Folha de Sao Paulo, 5 March 1989, A-10, translated and reported in FBIS LAT-89-043, 7 March 1989, 40-41. Engesa and Brigadier Hugo de Oliveira Piva (retired) led the negotiations. Engesa was expected to subcontract INPE to build the satellite.

[152] "Government Offers to Sell Satellite to Iraq," (in Portuguese), Folha de São Paulo, 19 June 1989, A-8, translated and reported in FBIS LAT-89-119, 22 June 1989, 34.

[153] According to OESP, Embraer and Iraq were secretly negotiating a licensing agreement whereby Iraq could manufacture 40 Tucano EMB-312 trainers. The cost would be $100 million. Iraq now operates 80 such planes that were built by Egypt. A single plane is worth approximately $1.9 million. The contract includes components and support materials. "Iraq Wants License to Manufacture Tucano Planes," (in Portuguese), O Estado de São Paulo, 7 December 1988, 20, translated and reported in FBIS LAT-88-238, 12 December 1988, 35.

rocket launchers and SS-60 rockets. The contract terms, with new grace periods, were reportedly generous to Iraq.[154]

Iraq's major problem is financing such deals. It owed Avibrás $40 million for an earlier sale of the Astros II, and Avibrás suspended the shipment of arms. In February 1989 Iraq agreed to pay Brazil the first installment on its debt, leading to the resumption of arms deliveries.[155] In a separate case, Iraq owed Engesa $80 million on a sale of military vehicles, but paid that debt in October 1988.[156] Iraq's ongoing financial constraints limit the potential for Iraqi-Brazilian cooperation.

Iraq, Egypt, and Brazil are studying the possibility of a tripartite agreement on the production of the FLX, a supersonic pursuit plane that has been in the design stage by Embraer since 1987. Egypt and Iraq have already participated with Brazil on the Tucano project; they have 140 Tucanos between the two of the them (built in Egypt). The major problem with the FLX project is its cost. Cuts in government budget have put the project on

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[154] "More Brazilian Arms for Iraq," Defense & Foreign Affairs, February 1989, 39; Avibrás Negotiates New Accord with Iraq," (in Portuguese), O Globo, 22 February 1989, 21, translated and reported in FBIS LAT-89-060, 30 March 1989, 31.

[155] A Brazilian government guarantee of Iraq's debt also contributed to the resumption of deliveries and the subsequent 1989 contract.

[156] "Brazil Negotiates Rocket Sales to Iraq," Defence 20, no. 2 (February 1989): 83; "Brazilians Talk Rockets in Baghdad," Defense & Foreign Affairs Weekly 15, no. 5 (12 February 1989): 1.

hold. It is estimated that Brazil needs at least $2 billion for the project, and that 350 to 500 planes must be sold in order to make it feasible. The air forces of Iraq and Egypt have demonstrated a willingness to invest in the FLX, but no agreement between them has been reached to date.[157] The pattern of interaction between Brazil, Iraq, and Egypt, on the FLX project could be significant for future cooperation in space and ballistic missile programs.

4. Libya

Most worrisome for U.S. policy-makers is Brazil's relationship with Libya. In the late 1970s, Libya was Brazil's largest armaments customer. In 1983, Brazil suspended arms sales to Libya, in large part because of ongoing U.S. pressure. Under a February 1988 proposal, Libya offered to purchase $2 billion dollar worth of Brazilian armaments. Libya also offered Órbita $400 million a year for six years to help develop the MB/EE series of surface-to-surface missiles,[158] an offer that was

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[157] Roberto Godoy, "Iraqi, Egyptian Interest," (in Portuguese), O Estado de São Paulo, 22 October 1989, 29, translated and reported in FBIS LAT-89-242, 19 December 1989, 42.

[158] "Libya Offers to Finance Brazilian Missile Project," Jane's Defence Weekly 9, no. 5 (6 February 1988): 201; "While Libya Brings a Shopping List," Defense and Foreign Affairs Weekly 14, no. 4 (7 February 1988): 2; "High Level Libyan Military Delegation Visits Brazil," African Defence Journal 91 (March 1988): 7; "Brazil Offers Libyan Missile," Flight International 134, no. 4132 (24 September 1988): 9; "Libyan Military Mission Discussing Arms Deal," (in

confirmed by Órbita.[159] In addition to financing the program and purchasing the first lot of the series, a Libyan delegation expressed an interest in gaining access to the MB/EE technology. At the time, it was estimated that it would take five years to develop the MB/EE series.[160] Given the desperate financial state of most Brazilian arms producers at the time, the Libyan offer seemed attractive. Under intense U.S. and international pressure, though, Brazil backed off from such arrangements with Qaddafi. Such pressure will continue to limit the scope of Brazilian-Libyan interaction.

C. Others

Brazil has been involved on a lesser scale with other

Portuguese), O Globo, 21 January 1988, 21, translated and reported in FBIS LAT-88-015, 25 January 1988, 22; Roberto Lopes, "Weapons Manufacturers Seek Libyan Sales," (in Portuguese), Folha de São Paulo, 17 July 1988, A-9, translated and reported in FBIS LAT-88-138, 19 July 1988, p. 32. See also James Tomashoff and Lewis A. Dunn, "Some Implications of a Changing Third World Military Environment," Paper prepared for the Science Applications International Corporation (SAIC) Conference on the Changing Dimensions of the Third World Military Environment, McLean, Virginia, 20 June 1989, 18.

[159] "Libya Said Financing Missile Construction," (in Portuguese), Rede Globo Television, 3 February 1988, translated and reported in FBIS LAT-88-023, 4 February 1988, 32.

[160] Roberto Godoy, "Offers Missile Development Aid," (in Portuguese), O Estado de São Paulo, 22 January 1988, 2, translated and reported in FBIS LAT-88-015, 25 January 1988, 23.

suppliers of space and missile technology. It sought Swedish cooperation on a guidance panel that was originally developed by the Japanese.[161] In addition, Avibrás received technology from Switzerland's Oerlikon-Buehrle for the fieldguard system (called FILA in Brazil - Fighting Intruders at Low Altitudes), which makes the steering of missile artillery possible.[162] Brazil probably will continue to seek out small suppliers of space and missile technology, but in the long run, will depend more on the larger suppliers such as France and the PRC. Finally, Japan's ongoing development of its space program augurs well for Brazil.[163] Cooperation with the Japanese in space technology would not carry the political liabilities associated with the Soviets or Chinese.[164]

In sum, Brazil has sought a wide range of alternative suppliers for its space and missile technology. The most viable prospects are the MTCR signatories, especially France. Outside the MTCR, the Iraqis have reportedly suggested the most imaginative arrangements for financing Brazil's missile program.

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[161] "Problems, Achievements in Programs with Argentina, PRC," (in Portuguese), Tecnologia & Defesa no. 31, 1986.

[162] "Swiss Companies Outflank the Industrial Countries' Export Embargo," (original in German), Berner Zeitung, 3 January 1989.

[163] See "O Japão vai à Lua," Veja, 31 January 1990, 53.

[164] For a broad review of Brazilian-Japanese economic relations, see Leon Hollerman, Japan's Economic Strategy in Brazil: Challenge for the United States (Massachusetts: Lexington Books, 1988).

Negotiations with the Chinese and Soviets have led to numerous agreements, but with limited significance.

FINAL CONCLUSION

The strict observance of MTCR guidelines by the United States has succeeded in curbing the development of Brazil's space and ballistic missile programs and revealed Brazil's vulnerability in those critical areas. Critics of the present policy argue that the U.S. policy has:

(1) further strained Brazilian security relations with the United States;

(2) weakened U.S. influence over Brazil's rocket and missile programs;

(3) strengthened Brazilian ties with European suppliers (especially France) of space and missile technology;

(4) driven Brazil into closer technological cooperation with the PRC and the Soviet Union; and

(5) intensified Brazilian negotiations with Iraq and Libya.

Even in the absence of the MTCR, Brazilian security relations with the United States may have deteriorated, and Brazil may have continued its movement toward Europe, the PRC, the Soviet Union, and the Middle East. While this may be true, the strict implementation of the MTCR increased the scope, intensity, and pace of the movement away from the United States.

In balancing the goal of ballistic missile non-proliferation with that of improved U.S.-Brazilian security relations, U.S.

policy-makers are faced with limited options and declining influence. Space technology is one of the few areas in which Brazil has remained dependent almost exclusively on the United States, but even this dependency is being challenged by Brazil as it diversifies its sources of technology. After the United States, France is undoubtedly the preferred alternative, but Brazil has also sought cooperation with the PRC, the Soviet Union, Iraq, and Libya, among others. Such a pattern of diversification is likely to increase Brazil's autonomy vis-à-vis the United States.

The limits of U.S. influence are most apparent in its inability to control major allies within the MTCR. The record demonstrates that while the United States can cajole and pressure its allies, it can by no means assume that it can limit their transfers of space or missile technology. The United States has even less control over the Soviet Union and the PRC, and is virtually powerless in restraining Brazilian ties with those countries.

Brazil's growing autonomy in the area of space rocketry and possible development of ballistic missiles reflects a changing international system, where the strategic, economic, ideological, and political assumptions of bipolarity have increasingly given

way to the realities of multipolarity.[165] Even if it can be posited that the strategic assumptions of bipolarity have lagged behind those of an economic, ideological, and political nature (the "bi-multipolarity" argument),[166] it is clear that the consensus on ballistic missile non-proliferation is weak. This suggests that the international environment is, in fact, increasingly multipolar, and that U.S. influence within the system is in relative decline. The concomitant rise of Europe, Japan, the PRC, and other actors in the international system has opened new opportunities for Brazil.

Brazil's movement away from the United States is not cost-free. In diversifying its ties with other suppliers of space and missile technology, Brazil is paying a high cost in the short-term. Brazil will remain dependent on external sources for its space and missile technology for years to come, but by diversifying those sources, Brazil will become less vulnerable to

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[165] For a discussion of this change, see James R. Kurth, "The United States, Latin America, and the World: The Changing International Context of U.S.-Latin American Relations," in Kevin J. Middlebrook and Carlos Rico, editors, The United States and Latin America in the 1980s (Pittsburgh, Pennsylvania: University of Pittsburgh Press, 1986): chapter 1.

[166] For a review of theories on international system structure (multipolarity, bipolarity, etc.) and stability, see James E. Dougherty and Robert L. Pfaltzgraff, Jr., Contending Theories of International Relations: A Comprehensive Survey (New York: Harper and Row, 1981, second edition): 162-168. For a review of bi-multipolarity, see Richard N. Rosencrance, "Bipolarity, Multipolarity, and the Future," Journal of Conflict Resolution, 10 (September 1966): 318.

U.S. actions. Brazilian policy-makers have decided that the long-term benefits of such diversification exceed their costs.

The U.S. policy of denying space and missile technology to Brazil leaves one with a sense of déjà vu. In the mid-1970s, the United States sought to limit the transfer of nuclear technology to Brazil and was subsequently replaced by West Germany as the major supplier of such technology. Eventually, Brazil embarked upon a "parallel" (indigenous) nuclear program that has produced significant results. Under the nuclear regime, arguably the most restrictive of its kind, Brazil has demonstrated that with political will, it may be able to achieve nuclear weapons capabilities - though at a higher cost and at considerable delay. Under the less restrictive ballistic missile regime, there is little doubt that Brazil eventually will achieve a medium-range ballistic missile capability if it so chooses. When it attains such a goal, it will be with greater autonomy vis-à-vis the United States than it has enjoyed at any time in the post-World War II period.

In closing, the systemic changes discussed above, while conditioning the parameters within which the United States can act, are by no means deterministic. The inauguration of President Fernando Collor de Mello on 15 March 1990 could signal a new opportunity for the United States to improve security and trade relations with Brazil, especially if Collor de Mello

succeeds in implementing the internationalist development strategy he has charted. Cooperation could be attained only through careful negotiations, mutual respect, and sufficient incentives and guarantees for each country. The United States could signal its willingness to cooperate by transferring space technology within category II of the MTCR. Measures of reciprocity on the part of Brazil could include signing the NPT, accepting in full the Tlatelolco Treaty, endorsing agreements that prohibit the diversion of space technology to the ballistic missile program, etc. The opportunity for the United States to nurture the Brazilian space launch program is rapidly slipping away to foreign sources. If the United States waits much longer to pursue such cooperation, it is doubtful whether a sudden liberalization of MTCR restrictions on the part of the United States could alter significantly the present pattern. If the United States seizes the opportunity, it may be able to improve relations with Brazil without jeopardizing its commitment to ballistic missile non-proliferation.

APPENDIX

MISSILE TECHNOLOGY CONTROL REGIME

STATEMENT BY THE ASSISTANT TO THE PRESIDENT FOR PRESS RELATIONS

APRIL 16, 1987

The President is pleased to announce a new policy to limit the proliferation of missiles capable of delivering nuclear weapons. The U.S. Government is adopting this policy today in common with the governments of Canada, France, the Federal Republic of Germany, Italy, Japan, and the United Kingdom. These nations have long been deeply concerned over the dangers of nuclear proliferation. Acting on this concern, these seven governments have formulated Guidelines to control the transfer of equipment and technology that could contribute to nuclear-capable missiles. This initiative was completed only recently, following several years of diplomatic discussions among these governments. The fact that all seven governments have agreed to common guidelines and to a common annex of items to be controlled serves to prevent commercial advantage or disadvantage for any of the countries. Both the Guidelines and its Annex will be made available to the public.

The President wishes to stress that it is the continuing aim of the United States Government to encourage international cooperation in the peaceful use of modern technology, including in the field of space. The Guidelines are not intended to impede this objective. However, such encouragement must be given in policies of the U.S. Government.

The United States, and its partners in this important initiative, would welcome the adherence of all states to these guidelines in the interest of international peace and security.

MISSILE TECHNOLOGY CONTROL REGIME: FACT SHEET TO ACCOMPANY PUBLIC ANNOUNCEMENT

The United States Government has, after careful consideration and subject to its international treaty obligations, decided that, when considering the transfer of equipment and technology related to missiles whose performance in terms of payload and range exceeds stated parameters, it will act in accordance with the attached Guidelines beginning on April 16, 1987.

GUIDELINES FOR SENSITIVE MISSILE-RELEVANT TRANSFERS

1. The purpose of these Guidelines is to limit the risks of nuclear proliferation by controlling transfers that could make a contribution to nuclear weapons delivery systems other than manned aircraft. The Guidelines are not designed to impede national space programs or international cooperation in such programs as long as such programs could not contribute to nuclear weapons delivery systems. These Guidelines, including the attached Annex, form the basis for controlling transfers to any destination beyond the Government's jurisdiction or control of equipment and technology relevant to missiles whose performance in terms of payload and range exceeds stated parameters. Restraint will be exercised in the consideration of all transfers of items contained within the Annex and all such transfers will be considered on a case-by-case basis. The Government will implement the Guidelines in accordance with national legislation.

2. The Annex consists of two categories of items, which term includes equipment and technology. Category I items, all of which are in Annex Items 1 and 2, are those items of greatest sensitivity. If a Category I item is included in a system, that system will also be considered as Category I, except when the incorporated item cannot be separated, removed or duplicated. Particular restraint will be exercised in the consideration of Category I transfers, and there will be a strong presumption to deny such transfers. Until further notice, the transfer of Category I production facilities will not be authorized. The transfer of other Category I items will be authorized only on rare occasions and where the Government [A] obtains binding government-to-government undertakings embodying the assurances from the recipient government called for in paragraph 5 of these Guidelines and [B] assumes responsibility for taking all steps necessary to ensure

that the item is put only to its stated end-use. It is understood that the decision to transfer remains the sole and sovereign judgment of the United States Government.

3. In the evaluation of transfer applications of Annex items, the following factors will be taken into account:

   A. Nuclear proliferation concerns;
   B. The capabilities and objectives of the missile and space programs of the recipient state;
   C. The significance of the transfer in terms of potential development of nuclear weapons delivery systems and other than manned aircraft;
   D. The assessment of the end-use of the transfers, including the relevant assurances of the recipient states referred to in sub-paragraphs 5.A and 5.B below;
   E. The applicability of relevant multilateral agreements.

4. The transfer of design and production technology directly associated with any items in the Annex will be subject to as great a degree of scrutiny and control as will the equipment itself, to the extent permitted by national legislation.

5. Where the transfer could contribute to a nuclear weapons delivery system, the Government will authorize transfers of items in the Annex only on receipt of appropriate assurances from the government of the recipient state that:

   A. The items will be used only for the purpose stated and that such use will not be modified nor the items modified or replicated without the prior consent of the United States Government;

   B. Neither the items nor replicas nor derivatives thereof will be retransferred without the consent of the United States Government.

6. In furtherance of the effective operation of the Guidelines, the United States Government will, as necessary and appropriate, exchange relevant information with other governments applying the same Guidelines.

7. The adherence of all States to these Guidelines in the interest of international peace and security would be welcome.

SUMMARY OF THE EQUIPMENT AND TECHNOLOGY ANNEX

[Only the full text of the Annex is authoritative, and it should be consulted for precise details.]

Category I

- Complete rocket systems [including ballistic missile systems, space launch vehicles, and sounding rockets] and unmanned air vehicle systems [including cruise missile systems, target drones, and reconnaissance drones] capable of delivering at least a 500 kg payload to a range of at least 300 km as well as the specially designed production facilities for these systems.

- Complete subsystems usable in the systems in Item 1, as follows, as well as the specially designed production facilities and production equipment therefor.

- Individual rocket stages;

  - Reentry vehicles;
  - Solid or liquid fuel rocket engines;
  - Guidance sets;
  - Thrust vector controls;
  - Warhead safing, arming, fuzing, and firing mechanisms.

Category II

- Propulsion components.
- Propellants and constituents.
- Propellant production technology and equipment.
- Missile structural composites: production technology and equipment.
- Structural materials.
- Flight instruments, inertial navigation equipment, software, and production equipment.
- Flight control systems.
- Avionics equipment.
- Launch/ground support equipment and facilities.
- Missile computers.
- Analog-to-digital converters.
- Test facilities and equipment.
- Software and related analog or hybrid computers.
- Reduced observable technology, materials, and devices.
- Nuclear effects protection.

LIST OF ACRONYMS

CGWIC - China Great Wall Industrial Corporation

CMFA - Comando Geral das Forças Armadas (Armed Forces Joint Command)

COBAE - Comissão Brasileira de Atividades Espaciais (Brazilian Commission of Space Activities)

CTA - Centro Técnico Aerospacial (Aerospace Technical Center)

Embraer - Empresa Brasileira de Aeronáutica S.A.

EMFA - Estado Maior das Forças Armadas (General Staff of the Armed Forces)

Engesa - Engenheiros Especializados S.A.

Esca - Engenharia de Sistemas de Controle de Automação S.A.

FILA - Fighting Intruders at Low Altitudes

FRG - Federal Republic of Germany

IAE - Instituto de Atividades Espaciais (Space Activities Institute)

IAEA - International Atomic Energy Agency

Imbel - Indústria de Material Bélico do Brasil

INPE - Instituto Nacional de Pesquisas Espaciais (National Institute of Space Research)

Inscom - International Satellite Communication

MECB - Missão Espacial Completa Brasileira (Brazilian Complete Space Mission)

MTCR - Missile Technology Control Regime

NASA - National Aeronautics and Space Administration

NPT - Nuclear Non-Proliferation Treaty

Parcom - Participações e Consultoria

PRC - People's Republic of China

LIST OF ACRONYMS (continued)

SBTS - Sistema Brasileiro de Telecomunicações para Satélite

VLS - Satellite Launching Vehicle

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