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# NUCLEAR POWER IN BRAZIL

by

MAX G. MANWARING

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**T**o the present time, only the United States, the Soviet Union, the United Kingdom, France, China, India, and possibly Israel have acquired nuclear weapons. But it is only a matter of time before additional countries join this nuclear club. The prospect of a proliferation chain including Argentina and Brazil has been recognized for some time. Much has been said about Argentine nuclear potential as a result of success in mastering the nuclear fuel cycle, announcements that the country is now capable of making its own nuclear weapons, and statements elaborating that this technology would become a fundamental tool in its foreign policy.<sup>1</sup> The nuclear situation in Brazil, however, remains somewhat obscure.

What the further spread of nuclear weapons development capability might do to the international system is a compelling question, but not within the scope of this article.<sup>2</sup> My purpose is more limited: first, to analyze briefly the roots and functioning of Brazilian nuclear development policy in light of the military-political elite's geopolitical thought; and then to examine the basics of the program that Brazil is, in fact, implementing. Through the fusing of attitude and behavior, one can gain a clear picture of the present status of the nuclear industry in Brazil and its possible significance in the hemisphere and the world.

## GEOPOLITICS AND NUCLEAR POLICY

The wellsprings of current policy are to be found in the concepts of Brazilian

geopolitical thinking. The major contemporary figure has been General Golbery da Couta e Silva.<sup>3</sup> Much of present governmental policy—and much of what is being done—is a result of research done over the years at the Superior War College and synthesized by Golbery. As a result, the military-backed regimes that have been in power since 1964 have been provided with a conceptual framework for the dynamic economic, political, social, and military development of the country. Moreover, Golbery has held positions of great influence in all the administrations since 1964 and thus has been present to interpret and continue to develop contemporary geopolitical thinking as it applies to Brazil.

Golbery argues that Brazil must develop itself or perish.<sup>4</sup> Development, in the most simple terms, consists of two elements, security and economic growth. More specifically, security involves the defense of economic and political sovereignty in a world that is becoming more and more aggressive. Economic growth means continued and expanded participation in building the nation's agricultural and industrial base. Brazilian nuclear policy is a manifestation by which the nation expresses its will to live, to develop, and to preserve itself within the framework of the international community. In order to attain these objectives, a "creative minority," generally from within the armed forces, will seek to carry out the necessary implementation programs and has the overall responsibility to make Brazil into a real nation.<sup>5</sup>

The nation's nuclear development policy, therefore, is derived from its broad economic and political goals, and is not just a means of producing energy. In this sense, nuclear policy is to establish a nuclear power industry that can serve as a means by which Brazil might transform itself from an obscure third world "dependency" into an autonomous power center in its own right.<sup>6</sup>

The first indication that this would be the case came in 1967 when then-President Costa e Silva stated that one of the major objectives of his administration would be the attainment of necessary foreign cooperation for the rapid nuclearization of Brazil.<sup>7</sup> Solid evidence to this effect came in 1968 when Brazil signed and ratified the Treaty of Tlatelolco (though through a procedural ruse, it remains legally unbound).<sup>8</sup> Further evidence was provided when the 1973 oil crisis and subsequent quadrupling of energy prices brought the Brazilian "economic miracle" to an untimely halt. Under those circumstances the government responded with a massive \$65 billion, 12-year commitment to the development of internal energy resources, including nuclear energy.<sup>9</sup>

Then, in 1974, NUCLEBRAS was founded as a state company with a charter to provide direction for the nation's nuclear policy.<sup>10</sup> At the same time, the decision was made to establish an independent all-Brazilian nuclear program based on an enriched uranium technology, to which the country was already committed. The United States let it be known that no new contracts would be let for the supply of enriched uranium and that existing nuclear agreements with Brazil were subject to review.<sup>11</sup> This motivated the Geisel administration to seek its nuclear technology elsewhere. As a result, a multibillion-dollar agreement was signed with the Federal Republic of Germany in June 1975. Fulfillment of the terms of this agreement would provide Brazil with a full nuclear cycle and eight reactors, in addition to one that was already under construction, Angra I. Subsequent supplemental agreements have been made with the Netherlands, France, Britain, and the United States.<sup>12</sup>

Since 1975 and the beginning of the transfer of technology under the terms of the agreement with Germany, several things have taken place which confuse the issue of Brazilian nuclear development. First, there were—and still are—several problems in the construction of the reactors. Thus, the program of power plant construction is now considerably behind schedule. Second, the Germans have been accused of deliberately slowing the Brazilian nuclear program.<sup>13</sup> Especially critical comments suggest that foreign interests are subjecting the country to "blackmail."<sup>14</sup> Third, the burdens imposed by the large Brazilian external debt have forced the government to make statements to the effect that after dealing with the problem, the country "has nothing left over for development."<sup>15</sup> It appeared by mid-1982, then, that the Brazilian nuclear program was substantially diminished, if not completely halted.

Nevertheless, President Figueiredo has pursued a policy that is very much in accord with that of his predecessors. The following measures are among the steps that have been taken to maintain the momentum of—or bring back on track—Brazilian nuclear development.

First, in June 1982 the Mines and Energy Minister, Caesar Cals, hinted that the priority for construction of reactors was being downgraded for economic reasons. He explained that new nuclear power plants would be begun only when the problem of uranium

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enrichment had been fully resolved.<sup>16</sup> Significantly, it was also suggested that the government would like to wait until Brazilian scientists develop the ability to build fast-breeder reactors that would use thorium instead of uranium. The argument is that fast-breeder reactors produce ten times the plutonium that would be produced from reactors built with German technology.<sup>17</sup> Moreover, it has been estimated that it would take 7800 years to use up all known Brazilian thorium even if that element were used to provide all Brazilian demands for electricity.<sup>18</sup> In both cases, the implications are clear: even by delaying the program somewhat, Brazil will obtain more plutonium over a shorter period of time by using an element found in great abundance in that country.

Second, while the German fuel cycle is being transferred, Brazil appears to be developing a parallel program that would be exclusively Brazilian. Evidence of such a program may be seen in the construction of an all-Brazilian uranium processing plant at Itataia, and in current research that would lead to uranium enrichment using laser rays, fast-breeder reactors using thorium, and the planning of all-Brazilian fuel fabrication and reprocessing plants.<sup>19</sup> Furthermore, in early 1983, all research in the field of nuclear energy was centralized under the control of the federal government. Private and state institutions are still allowed to carry out nuclear research, but only through a coordinating agreement with NUCLEBRAS.<sup>20</sup> At the same time, Brazil continues to pay for and take delivery of German equipment for its nuclear power plants.<sup>21</sup>

Third, despite publicly announced budget cuts of up to 47 percent from the 1983 nuclear program,<sup>22</sup> large portions of the cuts do not, in reality, appear to have been made.<sup>23</sup> For example, \$100 million supplements were provided to the NUCLEBRAS budget in 1982 and were expected for 1983 and beyond.<sup>24</sup> This has been accomplished by, among other things, taking from the budget for scientific and technical development,<sup>25</sup> reducing highway and railroad construction and the development of

communications,<sup>26</sup> obtaining international loans,<sup>27</sup> and deficit spending on the part of NUCLEBRAS.<sup>28</sup> For 1984, the President of NUCLEBRAS, Dario Gomes, reportedly expected a budget of \$750 million.<sup>29</sup>

Finally, in December 1983 the International Atomic Energy Agency (IAEA) was officially notified that the Brazilian government would, again, not sign the Nuclear Non-Proliferation Treaty. In that communication, the Foreign Minister, Ramiro Saraiva Guerreiro, noted that not all the countries "that are filled to the brim with megatons, such as France, India, and the People's Republic of China, are signatories to the treaty." He added that "the countries that underscore the importance of the treaty are precisely those which proliferate nuclear arms, such as the USSR, the United States, and Great Britain."<sup>30</sup> Thus, Brazil continues to be legally uncircumscribed by any international nuclear control measures.

Through various means and the guiding geopolitical premises for development, the goals of Brazilian nuclear policy have endured from the late 1960s, and the Costa e Silva administration, to the present. Barring some great catastrophe, this policy is unlikely to change in the foreseeable future. Clearly, the policy is to continue to develop nuclear power. And the implementation of that policy is of relatively high priority.

An examination of the programs that carry out nuclear development policy will further clarify the situation and make the political, economic, and military implications more explicit.

#### THE BASICS OF THE PROGRAM

Given Brazilian strategic thinking, a large and independent nuclear power production capability is a necessity for the country. Such a capability would resolve energy problems, provide for the creation of a large and lucrative new industry, and establish the potential to enhance national security. In this context, the nuclear development program is the crowning point in the realization of Brazil's long-touted greatness. Consequently, there are three

complementary parts of the program: nuclear power production, a nuclear weapon production capability, and the development of the additional capability of delivering nuclear weapons.

*Nuclear Power Production.* This part of the program has been in progress since the 1930s,<sup>31</sup> but did not get beyond the seminar room and laboratory until 1972 when construction was begun at the nuclear power plant at Angra dos Reis (Angra I). However, the establishment of an independent, full nuclear cycle involves four basic components in addition to the construction of reactors: uranium and/or thorium production, fuel enrichment, fuel fabrication, and reprocessing.

With regard to the power plants, the 1975 agreement with the Federal Republic of Germany included provisions for the construction of eight reactors of 1380 megawatts each, in addition to the 626-megawatt Angra I plant. All of these plants were to have been in operation before 1990. However, as noted above, because of a lack of funds and the political decision giving priority to the mastering of the nuclear fuel cycle, reactor construction is not on schedule. Furthermore, at this point it is not certain that all eight reactors will be built. The status of reactor construction as of early 1984 is as follows. Angra I was scheduled to go into operation in 1977 but is currently operating at only 30 percent of capacity. Angra II is not likely to be completed in 1987 as scheduled. Angra III has had its site moved, but heavy equipment for it has arrived from Germany and construction was scheduled to begin in 1984. Preparations at the worksites for Peruibe IV and V have been delayed. And construction contracts for Iguade I and II will not be let until 1987. According to Mines and Energy Minister Cesar Cals, the plants to be contracted for in 1987 can be operational in 1997.<sup>32</sup>

NUCLEBRAS Mineral Resources Director John Albuquerque Forman has stated that current Brazilian uranium reserves of 301,490 tons will feed 48 pressurized water reactors for 30 years.<sup>33</sup> As a result, these reserves can easily guarantee fuel supply to the nuclear plants foreseen in the nuclear

development program. Currently, uranium concentrates are being produced at the NUCLEBRAS mining and industrial complex at Poco de Caldas. This facility was opened in May 1982 and has the capacity to provide 500 metric tons of yellow-cake a day.<sup>34</sup> Also, another type of uranium production plant at Itataia—utilizing all-Brazilian technology—was scheduled for completion in mid-1984.<sup>35</sup> Reportedly, the French government is providing substantial financing for this project in return for part of the uranium produced.<sup>36</sup> In any case, it appears that despite severe financial constraints, Brazil is moving toward an adequate fuel production capability for its reactors.

A uranium enrichment plant at Resande was to be producing on an industrial scale as early as 1986.<sup>37</sup> However, construction has stopped due to a lack of funds. It is estimated that in order to deal successfully with this part of the nuclear power production process, Brazil would have to invest \$2.2 billion over the next two years.<sup>38</sup> Consequently, a Brazilian research program is under way which is aimed at developing a technique to use laser rays as an alternative to the German-designed centrifugal jet (jet nozzle) process.<sup>39</sup> The importance of this research is reflected in the fact that the project is being undertaken at three different institutions—the Institute for Nuclear and Energy Research, the Aerospace Technology Center, and, possibly, at the University of Campinas.<sup>40</sup> Uranium enrichment is, in fact, the key to the mastery of the nuclear fuel cycle, and until the problem is solved the Brazilian nuclear development program cannot come to fruition.

In the meantime, the basic engineering and pilot plants for fuel fabrication and reprocessing have reportedly been completed, but no dates have been fixed for expansion to commercial scale.<sup>41</sup>

It would appear, then, that Brazil has two nuclear power production programs—one very costly effort, based on the transfer of technology from Germany; and one which will be all-Brazilian, more economical, and ultra-modern, but which has not yet gotten a fuel enrichment plant into production.

Argentina has such a facility, although it relies on gaseous diffusion methods that have been in use in France, the USSR, and the United States for about 40 years. The latter point, however, is doubtless of little comfort to Brazilian decision-makers. It would seem likely that the Brazilian government will find the necessary means to provide new impetus for the quick establishment of a complete nuclear fuel cycle.

*Nuclear Weapon Production Capability.* If Brazil's primary purpose for creating a nuclear power production capability were simply to develop a military nuclear device, a far less complex and much less expensive program would probably have already achieved that goal. Moreover, on several occasions over the past several years, the various governments have reaffirmed the exclusively peaceful nature of the nuclear development program. Additionally, Brazilian representatives periodically confirm adherence to the principles of the Tlatelolco Treaty and have signed a safeguards agreement with the IAEA which exceeds the requirements of the Nuclear Non-Proliferation Treaty. Nevertheless, a nuclear explosive device produced for peaceful purposes can be as lethal and destructive as one designed for the military. A country exploding such a device would become, de facto, a nuclear power.

In the case of Brazil, it was expected that eight reactors would go into production, one a year from 1982 until 1989. This, of course, is no longer possible. But despite its late start and slowed development, Brazil's nuclear program—which includes a limited plutonium production capability even with the German technology—is theoretically capable of producing nuclear weapons. For example, even though Angra I is currently producing at only 30 percent of capacity, it has been estimated that Brazil could produce five 20-kiloton weapons a year.<sup>42</sup> The production from the reactors currently under construction, Angra II and III, along with Angra I will give Brazil a capability three times greater than that of such a celebrated nuclear power as India.<sup>43</sup> Finally, as each of the reactors projected for completion by 1997

comes on line, Brazil will take major steps toward a serious nuclear weapon production capability. They will produce approximately 11,000 megawatts a year—a little less than France was producing in 1980.<sup>44</sup>

*The Capability to Deliver Nuclear Weapons.* Brazil's theoretical capability to manufacture nuclear weapons is complemented by its ability to deliver such devices. For a number of years, the Brazilian air force has had jet aircraft that can deliver nuclear payloads.<sup>45</sup> The Brazilian navy will also become involved when A-4 Skyhawks become operational aboard the aircraft carrier *Minas Gerais*.<sup>46</sup> Perhaps more importantly, a long-standing missile project has been developing a series of rockets for the relatively well-funded Brazilian space program.<sup>47</sup> Thus, there is now a family of missiles in being. Sonda I has a capacity to carry loads of five kilograms to altitudes of 75 to 120 kilometers. Sonda II is capable of carrying loads of 20 to 50 kilograms to altitudes of 120 to 200 kilometers. Sonda III can take 50 kilograms to an altitude of 500 kilometers; and Sonda IV is capable of carrying 300 kilograms more than 1000 kilometers into space.<sup>48</sup> Moreover, it has been reported that experts working at the Aerospace Technology Center say that a missile is being planned that will be capable of carrying a payload of 1000 kilograms approximately 3000 kilometers.<sup>49</sup>

With a dual delivery capability, a nuclear power production capability, and the theoretical ability to manufacture a nuclear explosive device, implications are again clear. Brazil would need only a political decision to develop nuclear weapons.

## CONCLUSIONS

Mastery of the complete nuclear fuel cycle is one thing, the ability to deliver nuclear weapons is another, and a political decision to produce nuclear weapons is something else again. To this point, Brazilian leaders have been content to continue research and nuclear power development in consonance with the political decision to establish a vast independent nuclear power

industry designed to produce energy for peaceful purposes. Nevertheless, this program is a manifestation of geopolitical thinking which has military and political overtones, as well as economic ramifications.

Nuclear power is the capstone of Brazilian modernization. It is the military which has the responsibility to project the country into the world arena as a major power. All the great powers are also nuclear powers. Consequently, nuclear power is also the means by which Brazil will achieve major power status. The question of why the political decision has not been made to create larger and more formidable military forces and to produce nuclear weapons for them is answered, in part, by the fact that Brazil has not yet readied its capstone. A well-established, working, and totally Brazilian nuclear industry is absolutely necessary before a credible military program can be maintained in world-class competition.

#### NOTES

1. The official announcement of Argentine success in mastering the fuel cycle came in a press communique read by Argentine Foreign Minister-designate Dante Caputo at the Hotel Panamericano on 5 December 1983. Previous interviews with Vice-Admiral Carlos Castro Madero, chairman of the National Atomic Energy Commission, elaborated this technology as a fundamental tool for Argentine foreign policy in, for example, his interview on the "28 Millones" program, Television Color Network, 31 November 1983.

2. However, if the potential for conflict is real, the opportunities for its control are also real. In this connection, the Treaty of Tlatelolco and the Nuclear Non-Proliferation Treaty could be made more effective and realistic. As these nuclear control measures are improved, they will reduce the risk of conflict as a result of accident or miscalculation; and, bit-by-bit, pave the way toward a more secure and peaceful world. Policymakers representing the "nuclear club" and those countries such as Brazil which have the potential capability of playing a major role in the international security system have a clear responsibility. The problem is to rethink, improve, and revitalize relevant arms control measures before any given dispute reaches crisis proportions.

3. Golbery's most important books are: *Planejamento Estrategico* (Rio: Biblioteca do Exercicio, 1955); *Aspectos Geopoliticos do Brasil* (Rio: Biblioteca do Exercicio, 1957); and, *Geopolitica do Brasil* (Rio: Jose Olympica, 1967).

4. Golbery, *Aspectos Geopoliticos do Brasil*, p. 66.

5. President Humberto Castelo Branco, speech to the congress on 31 March 1965 in commemoration of the revolution.

6. Ibid.

7. President Artur da Costa e Silva, pronouncement of foreign policy at the *Palacio Itamaraty* (Ministry of External Relations) in Brasilia, 5 April 1967.

8. The provisions of the treaty are binding only when all Latin American states (and other states party to the treaty) have acceded to both its protocols. This restriction may be waived by the Latin American countries. Brazil has not, however, waived this provision and thus remains legally unbound by the treaty. For further analysis of the potential of the Treaty of Tlatelolco see John Maddox, *Prospects for Nuclear Proliferation*, Adelphi Paper 113 (London: IISS, 1975), pp. 7-8.

9. Normal Gall, "Atoms for Brazil, Dangers for all," *Foreign Policy*, No. 23 (Summer 1976), p. 195.

10. Republica Federativa do Brasil, *O Programa Nuclear Brasileiro*, March 1977. However, although NUCLEBRAS is under the jurisdiction of the Ministry of Mines and Energy, in reality it functions as a separate agency.

11. For more information on the inability or unwillingness of the United States to guarantee long-term enrichment services, see John R. Redick, "Nuclear Proliferation in Latin America," in *Latin America's New Internationalism: The End of Hemispheric Isolation*, ed. Roger W. Fontaine and James D. Theberge (New York: Praeger, 1976).

12. "Brazil-FRG Agreement on Cooperation in the Field of Peaceful Uses of Nuclear Energy," *The Brazilian Nuclear Program* (Rio de Janeiro: Federative Republic of Brazil, n.d.), p. 7; *Strategic Survey*, 1977, and *Strategic Survey*, 1978 (London: IISS), pp. 129, 139, and 138, respectively.

13. All a German spokesman could say in rebuttal was that the transfer of the fuel cycle "is less off-schedule than the construction of the nuclear reactors." See: Wolfgang Breyer in *Estado do Sao Paulo*, 20 September 1982, p. 26.

14. Similar charges are being made in Argentina. See *Buenos Aires Herald*, 20 November 1983, p. 1.

15. See Warren Hoge, "Angry Brazilian Chief Vows to Halt Rightist 'Thugs,'" *The New York Times*, 16 September 1980, p. A2.

16. *O Estado de Sao Paulo*, 24 September 1982, p. 26.

17. *O Estado de Sao Paulo*, 3 July 1983, p. 25.

18. *O Journal do Brasil*, 10 July 1982, p. 12.

19. *O Estado de Sao Paulo*, 25 November 1982, p. 34; *O Estado de Sao Paulo*, 24 September 1982, p. 26; and *Manchete*, 4 December 1982, pp. 76-84.

20. Richard House, "Brazil's Nuclear Dream Falter," *The Washington Post*, 12 February 1983, p. A8.

21. *Braslian Domestic Service*, 31 January 1984.

22. House, p. A8.

23. Such statements are apparently smokescreens. For example, the 1983 army budget was cut by 12 percent; however, it is expected that supplementary credits will be released later in the year—as has been the case in the past. See statement of General Leonidas Pires Goncalves, *O Estado de Sao Paulo*, 7 September 1982, p. 5.

24. For example, NUCLEBRAS announced in 1982 that \$100 million in supplementary funds would be contracted every year for the next ten years. See *O Globo*, 9 October 1982, p. 19.

25. See the breakdown of the scientific-technical development budget in *Correio Braziliense*, 21 January 1983, p. 11.

26. *O Globo*, 9 October 1982, p. 19.

27. For example, \$200 million from the International Bank for Research and Development (IBRD) was to be part of a five-year, \$500 million program to support scientific and technical development in Brazil beginning in 1984. See *O Estado de Sao Paulo*, 2 June 1983, p. 18.

28. The 1982 deficit of NUCLEBRAS amounted to about \$100 million. See text of NUCLEBRAS Annual Report for 1982, in *Correio Braziliense*, 12 April 1983, pp. 8-9.

29. *Journal do Brasil*, 16 October 1983, p. 1.

30. *TELAM*, Buenos Aires, 13 December 1983.
31. *A Energia Nuclear no Brasil* (Rio de Janeiro: Biblioteca do Exército Editors, 1979), p. 17.
32. *Folha de Sao Paulo*, 22 December 1983, p. 17.
33. *O Globo*, 29 October 1983, p. 16.
34. *O Estado de Sao Paulo*, 22 August 1982, p. 49.
- Yellow-cake is the final precipitate formed in the milling of uranium ores.
35. *O Estado de Sao Paulo*, 25 November 1982, p. 34.
36. *Folha de Sao Paulo*, 22 December 1983, p. 17.
37. *O Estado de Sao Paulo*, 2 July 1982, p. 29.
38. *O Globo*, 27 November 1983, p. 42.
39. *O Estado de Sao Paulo*, 24 September 1982, p. 26.
40. *O Globo*, 3 December 1983, p. 18.
41. *Latin American Daily Post*, 21 October 1982, p. 1; and *Latin American Weekly Report*, 31 July 1981, p. 10.
42. *The Evolving Strategic Environment* (Carlisle Barracks, Pa.: US Army War College, Strategic Studies Institute, 1979), p. 17.
43. *Ibid.*
44. *Power Reactors in Member States*, International Atomic Energy Agency, Vienna, Austria, 1980, p. 24.
45. *The Military Balance*, 1981-1982 (London: IISS, 1981), pp. 93-94.
46. General Delio Jardim de Matta, air minister, announced the air force and the navy are jointly buying A-4s for the "Minas Gerais" in *Folha de Sao Paulo*, 25 June 1983, p. 6.
47. Nearly ten billion cruzieros (\$40 million, US) were allocated for 1983. See *Correio Braziliense*, 21 January 1983, p. 11.
48. *Correio Braziliense*, 11 December 1982, p. 5; and *Manchete*, 4 December 1982, pp. 76-84.
49. *O Estado de Sao Paulo*, 9 December 1983, p. 1.

