BRAZIL

Atoms for Brazil, dangers for all

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The weight of Brazil in world affairs Increases every day. In a world full of disturbances and contradictions, the conduct of your country, Senhor Minister, appears as a factor of stability and equilibrium. ***Toast by the West German Foreign Minister on the eve of the signing of the Brazil-German nuclear sales agreement, June 1915.***

The 1975 nuclear deal between Brazil and West Germany is momentous in several ways. It is a major step toward diplomatic independence by two steadfast postwar allies of the United States in response to the upheavals in the world energy economy in the mid-1970s. It also would be the largest transfer ever made of nuclear technology to a developing country. This complex umbrella agreement threatens to establish a new kind of commercial rivalry for international sales of power reactors that could accelerate nuclear weapons proliferation in the final decades of this century.

If this agreement is fully implemented over the next 15 years, it would give the German reactor industry desperately needed export sales and fuel supplies. It also would meet Brazil's projected demand for atomic energy through 1990 and provide much of the technological base for Brazil to make nuclear weapons if she wished. The deal thus would satisfy the long-standing ambitions of both countries for greater nuclear "self-sufficiency" and would contribute toward realization of Brazil's historic dream of becoming a major power.

The Brazil-German agreement was negotiated in the months following the Indian nuclear explosion of May 1974. That event had a special psychological impact among developing countries, particularly Brazil and Argentina, the rival "near-nuclear" neighbors who both have refused to sign the 1968 Non-Proliferation Treaty (NPT). A New York Times editorial headlined "Nuclear Madness" spearheaded U.S. reaction to the deal. It called the agreement a "reckless move that could set off a nuclear arms race in Latin America, trigger the nuclear arming of a half-dozen nations else-where and endanger the security of the United States and the world as a whole".

The official Soviet reaction to the Brazil-German agreement was more cautious in expressing concern for nuclear proliferation, reflecting Moscow's perennial suspicion of Germany's intentions in the nuclear field while avoiding language that might disrupt her

own growing nuclear trade with Bonn. More than any other event in the rapid development of commercial nuclear power, the Brazil-German deal has led to intense questioning of the safety and viability of the international industry as presently organized. Some of the more important issues were raised in a speech by Senator Abraham Ribicoff a few days after the accord became public knowledge:

Hard economic times and the high price of oil have combined to establish a desperate need to sell and a desperate need to buy nuclear power reactors. Nothing less than balanced international payments and energy self-sufficiency are at stake. The resulting cutthroat nuclear competition is leading to the spread of plutonium reprocessing and uranium enrichment facilities. The capability to produce nuclear explosives is spreading "like a plague" in the words of the Inspector General of the International Atomic Energy Agency, who is responsible for detecting the diversion of peaceful nuclear materials to weapons development. In truth, the United States must assume a major share of the responsibility for the present nuclear proliferation problem. We pioneered the civilian nuclear power technology, made it available to other nations through our atoms for peace program and still clearly dominate the worldwide nuclear power industry. Closer attention should have been given to safeguards over the years, particularly to safeguards conditions on the re-export of U.S. nuclear technology by nations like France and West Germany.

The Deal

The centerpiece of the deal would be the sale to Brazil of between two to eight giant reactors, together worth from $2 to $8 billion, that would accelerate her nuclear energy program toward the goals of 10,000 megawatts of electricity generating capacity by 1990 and of producing 41 percent of Brazil’s total energy supply by 2010.

The basic design of the power plants to be built by the West German consortium Kraftwerk Union (KWU) was developed by Siemens, KWU’s senior partner, under license from Westinghouse, the world’s largest reactor manufacturer. Westinghouse suspended these licensing arrangements in 1970, after KWU was formed to compete with Westinghouse in the international market. The agreement, signed in Bonn on June 27, 1975, provides for creation of several mixed companies for joint Brazil-German participation in all phases of the nuclear energy industry, from prospecting for uranium ore in Brazil to the construction of reactors and the manufacture of components. The deal also calls for intensive training of Brazilian professionals in nuclear technology and heavy participation by Brazilian industry in the manufacture and construction program, which would enable Brazil eventually to become an exporter of nuclear fuels and equipment.

The deal would generate contracts for some 300 German firms and "now assures for the first time the stability" of 13,000 jobs in KWU’s own offices and factories. A leading German weekly observed that "the Federal Government already had invested DM 15 billion ($5 billion) in nuclear energy research out of tax monies — of which at least half was for basic research—and now this was finally to pay off". To obtain these benefits for West Germany, Bonn has assumed the entire financial risk for the deal through a consortium of five big banks lending $1 billion for KWU’s first two Brazilian power plants at concessionary interest rates. Half the debt will be financed at 7.25 percent by the Kreditanstalt für Wiederaufbau (Reconstruction Credit Institute), a development bank formed to distribute Marshall Plan aid.

The main political issue raised by the accord is Bonn’s commitment to provide Brazil with a uranium enrichment plant and a facility for reprocessing of spent fuel, from which plutonium could then be extracted. These plants could be used, alternatively, for the preparation and recycling of reactor fuels, or for the production of nuclear weapons. One of the striking features of the deal is that NUCLEBRAS, the new Brazilian state nuclear energy corporation, will actually finance development of the experimental German "jet nozzle" enrichment process (also known as the Becker process) now in the pilot plant stage into an industrial-scale operation.

Looking beyond the dangers of nuclear weapons proliferation in exports of the "complete fuel cycle," the Brazil-German deal reflects the centrifugal forces in the postwar international power structure that have been gaining momentum in recent years. At the height of U.S. influence, the principal supports of the western system were the American command of strategic nuclear weaponry, the role of the dollar in assuring monetary stability and U.S. control of critical fuel supplies through the overseas petroleum reserves held by the major oil companies and through the commitment of the U.S. Atomic Energy Commission (AEC) to provide enriched uranium for the West's nuclear power plants. Now all of these elements of U.S. power have declined in importance, forcing adherents to this power, such as Brazil and West Germany, to make bargains for themselves in a much more uncertain world.

In response to widespread criticism of the deal's dangers, West Germany obtained Brazil's reluctant agreement to a framework for international inspection that goes far beyond the safeguards required by the International Atomic Energy Agency (IAEA) to detect any diversion of nuclear equipment or materials for weapons production. These safeguards would cover not only the life of the agreement but also the useful life of all installations built under it and any application of technical "knowhow" acquired from the Germans to any other nuclear facilities built in Brazil.

"Knowhow" Safeguards

These new "knowhow" safeguards, to be applied for the first time in the Brazil-German deal, apparently now are becoming standardized in international sales of nuclear technology. This is a result of an agreement reached, at U.S. initiative, in a series of secret meetings in London of the principal supplier nations, known as the "Secret Seven," that were held throughout 1975. However, nobody seems to know how these technology safeguards will be implemented after enrichment and reprocessing plants with weapons-making potential are delivered to countries such as Brazil, whose military regime for the past decade has had a programmatic commitment to carrying out "peaceful" nuclear explosions.

Since there is no intrinsic distinction between a "peaceful" and a military nuclear device, the spread of these plants throughout the world could create a series of *de facto* situations clearly beyond the control of the international inspection machinery. This machinery is operated by the under-financed and under-staffed International Atomic Energy Agency, which is empowered only to report violations to the U.N. Security Council and has no enforcement mandate.

The text of the Brazil-German accord makes it contingent upon a safeguards agreement with the IAEA, assuring that these nuclear materials, equipment and installations, as well as the special fertile and fissionable materials produced in them, processed or used, and the respective technological information, are not used for nuclear weapons or other nuclear explosives.

However, the semiofficial commentary published with the text in the Brazilian press said:

For Brazil, this does not represent a commitment to forego nuclear devices in the future. One can presume that this does not rule out the possibility of Brazil developing her own technology based on knowledge acquired by Brazilian technicians who become familiarized, in time, with the jet-nozzle process.

Politically speaking, Brazil's nuclear deal with West Germany must be viewed in terms of the impact of the energy crisis on Brazil's rapid economic growth and on her historic aspiration to be a major power with a dominant role in South America. Under the pressures of the energy crisis Brazil has reached into the South American heartland to arrange for critical energy supplies with two of her weaker neighbors, Bolivia and Paraguay. These two deals are for natural gas from Bolivia and for a huge binational hydroelectric dam, ltaipu. to be built jointly with Paraguay. Both were negotiated over the opposition of Brazil's traditional rival, Argentina, which during the 1950s and 1960s developed a long lead over

Brazil in nuclear technology and has been suspected of attempting to fabricate nuclear weapons of her own.

While Brazil's power ambitions and geopolitical rivalries will be discussed more fully below it is worth stressing here that Brazil has been moving toward a new and still undefined role in world affairs in the tense climate created by the quadrupling of oil prices in 1973-74. As the *developing* world's leading oil importer, Brazil has been in deep balance-of-payments trouble since the 1973 Middle East war. Consequently, she has adopted a new "ecumenical pragmatism" in her foreign policy by which Brazil has moved closer to the Arabs diplomatically and has sought to diversify her export markets and her sources of energy, technology and foreign investment.

Explaining these policy departures in a lecture at Chatham House, London, in October 1975, Foreign Minister Antonio Azeredo de Silveira said:

During the Cold War, a rigid alignment with the leader of the Western Bloc was required of the nations of the developing world that share the basic values of the West. The reason for this or, if you prefer, the pretext was that the future of the entire system we belonged to was at stake and that unity was the price of survival. These realities no longer apply to the final quarter of this century, [and] an emergent power, with a wide range of interests in many fields, cannot allow rigid alignments, rooted in the past, to limit her action on the world stage.

Silveira voiced hope that the Brazil-German nuclear deal could lead to a "horizontal interdependence."

In Washington, the deal led to prolonged analysis of U.S-Brazilian relations. Partly as a result of these deliberations, Secretary of State Kissinger visited Brasilia in February and signed an agreement committing the foreign ministers of the United States and Brazil to an annual exchange of visits for consultations on world problems, an arrangement that Brazil had sought actively for two years.

The German Connection

The "horizontal interdependence" between Brazil and West Germany stems from the peculiar nature of Germany's own energy crisis. With no oil or uranium of her own, West Germany is now heavily dependent on petroleum imports and has staked her energy future on the world's largest per capita investment in nuclear power. This means construction of some 40 power stations, that would raise the nuclear share of her electricity supply from 7 percent in 1974 to 45 percent in 1985, an increase from 4 million to 88 million tons per year coal equivalent.

In implementing these plans, West Germany thus far has relied on supplies of enriched uranium sold by the U.S. government as the world's main nuclear fuel supplier, under long-term contracts with power plants throughout the non-communist world. Consequently, her energy position was severely compromised by the one-two punch delivered in 1973-74.

First came the oil price rises that accompanied the Arab boycott. Then came an important event that was little noticed in this country outside nuclear industry and government circles —the suspension by the U.S. Atomic Energy Commission of the signing of all new contracts for future supplies of enriched uranium. This occurred because in the surge of reactor orders in the early 1970s the projected commercial demands for enriched uranium were outstripping the capacity of the three AEC enrichment plants, the newest of which was built in 1956. In addition, the AEC retroactively classified as "conditional" enrichment contracts for 45 foreign reactors scheduled to begin operation in the early 1980s, including 2 in Brazil and 10 in West Germany.

Testifying that the enrichment cutback was a trigger to the Brazil-German deal, the top U.S. State Department science official told Congress: "We have run out of capacity. We saw that

coming. We did not take action". According to a spokesman for Westinghouse which is building Brazil's first nuclear power plant and was negotiating to build more:

We thought that we pretty well had that business locked up until the question of contracts between Brazil and the U.S. government for the slightly enriched uranium for fuel came to a sudden halt, and the Brazilians were denied firm contracts for the slightly enriched fuel, and at that point, any further industrial discussions between ourselves and the Brazilians ceased and Brazil started discussions with West Germany, with the results that were recently announced.

While it is not at all clear that Westinghouse had Brazil's future reactor orders "locked up" by July 1974, many specialists see the U.S. cutoff of future enrichment commitments as having created both a common interest and a tactical opportunity for Brazil and West Germany to act together to implement separate strategic aims. Brazil long has expressed interest in "self-sufficiency" in the nuclear fuel cycle for civilian and/or military purposes, while West Germany has wanted her reactor industry to make inroads into the fast-developing international nuclear energy market that has been dominated by U.S. manufacturers.

The loss by the major Anglo-American oil companies of direct control of most of the world's known oil reserves, coupled with the inability of the U.S. government to maintain its open-ended commitment to fuel the world's nuclear power plants, led West Germany in the mid-1970s to act as a catalyst of the independent ambitions of such countries as Brazil, Iran and South Africa in her search for new markets and critical fuel supplies.

West Germany's efforts to capture the Brazilian reactor market began in June 1968, shortly after Siemens won the Atucha-l contract in Argentina to build Latin America's first nuclear power plant. Foreign Minister Willy Brandt, during a Visit to Brazil, publicly expressed German interest in supplying Brazil with nuclear technology. A few months later a former Vice Minister of Foreign Affairs, Pio Correa. was hired as president of the Siemens subsidiary in Brazil. A bilateral agreement for scientific and technical cooperation was signed in 1969. A key role in these negotiations was played by the new president of NUCLEBRAS, Nogueira Baticta, who then became the minister-counselor of the Brazilian embassy in Bonn to implement the accord.

Brazilian technicians were sent to Germany for training in nuclear engineering, and in 1971 a formal working relationship was established between Brazil's National Council for Nuclear Energy (CNEN) and the Center for Nuclear Research in Julich (FRG), whose representatives were to play a key role in promoting exports of German nuclear technology. Visits of German scientists to Brazil under this agreement led to rumors, reported in the London Sunday Times, "of Germans conducting nuclear research in areas that would be ruled out if it were attempted on German soil." The Soviet Defense Ministry newspaper Red Star interpreted the 1969 scientific agreement as a German attempt to draw Brazil into its "atomic diplomatic game" and to encourage Brazil to reject the NPT.

Apparently, intensive negotiations with the Germans did not begin until after the U.S. cutoff of future contracts for enriched uranium in July 1974. A number of high West German officials visited Brasilia in mid-1 974 on secret business, among them State Secretary of Technology Hans Hilgar Haunschild, former Defense Minister Franz Josef Strauss and State Secretary for Foreign Affairs Hans George Sachs. Agreement on the Brazil-German deal was reached on Feb. 12, 1975. The U.S. ambassador in Bonn was informed a week later, and a general outline of the agreement filtered into the American trade press within a few days.

Meanwhile, the 38-year-old head of the "international section" of the Julich nuclear research center, Klaus Scharmer, defended Germany's new relationship with Brazil, arguing:

Brazil has the capacity—and will use it—to produce components and even build nuclear installations on her own. Only a partner that knows this aptitude can maintain fruitful contact for a long period. We thus saw that to try to cell installations to Brazil on a turnkey

basis would be an unwise policy. We must combat the "development gap" that tends to grow between countries that are more and less developed. We must try to hasten the advance of the underdeveloped.

Geopolitics of Uranium

On top of the intensifying competition for export markets, the disorder in the international reactor industry has been compounded by the new uncertainty about the future U.S. capacity to export enriched uranium, thus creating a new geopolitics of uranium supplies. After the AEC cutoff in 1974 of new enrichment contracts, the Soviets have become important suppliers of enriched uranium to Western Europe.

The West Germans, moreover, have been trying to diversify their sources of uranium by providing their own enrichment technology, the experimental Becker "jet nozzle" process, to two potential uranium suppliers, Brazil and South Africa. The Germans are reported to have secretly assisted the South Africans to develop something very similar to the jet nozzle technology they will be providing Brazil under the new deal. In October 1975, a West German airforce general was forced to resign when news leaked out of an undercover trip he made to South Africa that included a visit to a nuclear research center. Two months later, *The Economist report*ed that Iran, which is South Africa's main oil supplier and has an ambitious nuclear program of her own, may also finance commercial development of South Africa's jet nozzle process in return for guaranteed supplies and access to the technology.

Similarly, one of the main hopes for both sides in the Brazilian deal is that German geologists will help discover substantial uranium reserves that they believe to exist in Brazil. While Brazil has large proven deposits of thorium, a fertile material that can be made into reactor fuel and bomb material, no commercial technology has been developed so far for the use of thorium in power plants.

Brazil has greatly intensified her uranium exploration since 1969 but with uncertain results. What was initially reported in mid-1975 to be a major find of 50,000 tons of uranium ore, in the pre-Cambrian rock of the Brazilian shield in the sprawling inland state of Goiás, was modified two months later by an official estimate of only 1,500 tons. German geologists are now fanning out over the northern Amazon basin to seek new uranium deposits, with 80 percent of their exploration expenses subsidized by Bonn. This is because Brazil's present proven reserves are far from enough to pay, in any significant degree, for the huge transfer of nuclear technology that is envisioned for the next 15 years. Meanwhile, German firms have found valuable deposits in Namibia, South West Africa, and are also exploring for uranium in Austria, Algeria, Australia, Canada, Indonesia, Nigeria, Spain, Switzerland, Togo, and the United States.

Defending Bonn against criticism of the Brazil deal, Munich's leading newspaper observed that "the temporary export stop of the USA for uranium products made strikingly clear the dependence not only of the Federal Republic but also of the entire Western world on American fuel for nuclear reactors".

The increasing cost and uncertainty of oil supplies has stimulated ambitious plans in several countries for new atomic power plants that would increase the nuclear portion of the West's electrical generating capacity from today's 2 percent to 15 percent in 1985. But unexpected increases in both capital costs and time needed to build these plants have caused suspensions and cancellations of orders from utilities. The added capital outlays have tended to nullify the lower operating expenses that are the nuclear plants' main commercial advantage. Inflation is pushing the aggregate price tags of the West's nuclear power plants to between $1 and $1.5 trillion by the early 1990s.

At the same time, strong public opposition to nuclear power has spread from the United States to France, Germany, Japan, and Sweden, compounding the inflation and delay. Foreign demand for nuclear power plants has grown far laster than U.S. demand, with 50 percent more nuclear generating capacity already existing abroad. Both U.S. and European

reactor manufacturers have responded to inflation and delay at home by competing fiercely for export sales in third markets, especially in developing countries with authoritarian regimes that need not worry about public opposition to siting of nuclear power plants.

According to separate projections by the IAEA and AEC, the market for nuclear power among developing nations is likely to be concentrated in a handful of countries. The IAEA estimated that more than half the installed nuclear generating capacity by the year 2000 will be absorbed by only four nations—Brazil, India, Iran and Mexico—and that 70 percent of the same market will be concentrated in eight countries.

A more detailed study subsequently commissioned by the AEC, however, found even this limited market potential to be "too optimistic," due to extremely loose forecasts of electricity demand, ignorance of costs, shortages of foreign exchange and the inability of many national grids to absorb the output of large nuclear plants. This independent study, by Richard J. Barber Associates of Washington, stresses the importance of the sales push of companies and governments in developing this market:

Nuclear reactor system vendors have acknowledged, more or less openly, that many of the initial nuclear plants sold both domestically and internationally under "turnkey" arrangements were (and apparently still are, in the case of new reactor types) "loss leaders" for which the reported prices paid by utilities significantly understated the true cost of building the plants. Governments have clearly subsidized domestic and international power sales of their vendors by means of no-interest or low-interest loans, loan guarantees, absorption of research and development costs, preferential access to and pricing of fuck and reprocessing services, etc. The amount of such subsidies is often concealed, thus distorting the true cost of the power station ....The German Government, for example, underwrote the success of Siemens' sale to Argentina by giving the Argentine Government a five year no-interest loan, a subsequent very low interest loan, and balance of payments considerations. France managed to sell a reactor unit in Spain in return for loans covering 90 percent of its cost and agreeing to represent Spanish interests in the Common Market. It is common knowledge in nuclear industry circles that German, U.S. and Canadian vendors "lost their shirts" on their initial sales to Argentina, India and Pakistan.

Until the Brazil-German deal was negotiated, there had been little official concern or public discussion as to the economic wisdom and military implications of the drive to export, and even give away, nuclear reactors. The plutonium for India's 1974 explosion was diverted from the unsafeguarded "Cirus" research reactor donated by Canada in 1956, for which the AEC supplied heavy water. India's first nuclear power plant, built by General Electric, was financed with a $74 million U.S. foreign aid loan at 0.75 percent interest over 30 years, after a 10-year initial grace period, with additional support coming from the AEC and the Ford and Rockefeller Foundations [19].

With her own scientific community building on the technological base provided by the United States and Canada, India has created an immense network of nuclear facilities of all types, including her own plants for producing heavy water and for separating plutonium. The "Cirus" reactor located at the Trombay laboratories, near Bombay, alone employs 10,400 persons, including 2,400 scientists.

During construction of the plutonium separation facility at Trombay, senior Indian scientists repeatedly visited the AEC reprocessing plant in Idaho under the "Atoms for Peace" program, for extensive interviews with staff members on the technical problems of extracting plutonium from spent fuel. Today, India manufactures her own rockets and solid fuel propellant, and plans to launch rockets by 1979 capable of putting a 1,200-kilogram payload into orbit, or of delivering a nuclear warhead anywhere in Asia.

India's example has not been lost on other ascendant powers. While several countries are now trying to acquire nuclear technology with bomb-making potential. Brazil and India are

the only two developing countries carrying out space programs with their own launching facilities.

However risky and unprofitable the export trade in nuclear technology now may seem, this is precisely the direction in which the industry keeps moving. German and French reactor manufacturers, still marginal in the international industry, have fought for survival by seizing on the 1974 U.S. enrichment cutoff as an opportunity to win power plant sales by offering such "sweeteners" with bomb-making potential as the technology for uranium enrichment and for plutonium separation from spent fuel. Competing U.S. firms cannot legally offer these "sweeteners," but the pressure for them to do so is very great as escalating costs and political complications have shrunk the domestic market. In 1975 only 7 nuclear power plants were ordered in the United States, compared with 18 abroad.

At this time, too, a United States deal to build 8 nuclear plants in Iran is stalled in a dispute over Iran’s insistence on the right to reprocess her own spent fuel.

These broader economic and political considerations make the implementation of the Brazil-German deal a critical indicator of the future course of the international reactor industry. The compulsion to export is deeply felt in this high-risk capital-intensive, heavily-subsidized industry.

While the world energy crisis and the instability of the international reactor industry created the conditions for the Brazil-German nuclear deal, Brazil’s "great power" aspirations and the peculiar nature of her own energy crisis provided the incentives. Moreover, Brazil’s nuclear rivalry with Argentina made the risks of not seizing upon this opportunity unacceptable from a military point of view.

Although achieving power and prestige in proportion to her size long has been a major aim of Brazilian foreign policy, these ambitions had been taken seriously by the world only since the military seized power in April 1964. Tightly restricting mass consumption and civil liberties while providing incentives and guarantees that attracted large amounts of foreign investment, a succession of military regimes set the stage for the so-called Brazilian "miracle." This was a surge of rapid economic development crowned by a growth rate averaging 10 percent yearly in the 1967-74 period, a "miracle" that was a conspicuous beneficiary of low oil prices and of the radical expansion of the world’s money supply and trade in the postwar decades.

As industrialization advanced by giant strides, Brazilians began to see themselves emerging from the role of a "key country" in the global strategy of the United States to become an important military-political force in their own right. During the visit to Washington in 1971 of President Emilio Garrastazu Medici (1969-74), those aspirations were encouraged by President Nixon’s oft-quoted blessing: "As Brazil goes, so goes South America."

While Brazil’s relative geopolitical position has been strengthened greatly by the political disintegration of Argentina in the 1 970s, Argentina one day could recover sufficiently to inhibit Brazilian maneuvers in South America. At the same time, the energy crisis has become a crucial factor in Brazil’s future growth and influence. While Brazil today is the world’s fifth-largest country in area and seventh-largest in population, there is no other continental nation so deficient in economically useful deposits of fossil fuels.

Brazil’s main energy asset at present is the immense hydroelectric potential of her great rivers, which is being harnessed at an impressive rate. Hydroelectric production has increased thirteenfold over the past three decades and tripled since the mid-1960s, leading to fears that the water-flow potential near the major cities may be exhausted before the turn of the century. This is being given as the main economic justification for Brazil embarking on an ambitious nuclear power program, even though electricity demand is unlikely to continue growing at the rate of recent decades.

According to NUCLEBRAS President Paulo Nogueira Batista,

By 1980 our hydroelectric resources would be exhausted in the Southeast and the Sao Francisco Valley. We will still have at that time only the hydroelectric potential of the Amazon (90,000 megawatts), a good deal of which is in the region's north (far from markets)... The fad is that the installation of our nuclear reactors near the centers of consumption will enable these energy resources to be used right there without costly and wasteful long-distance transmission.

India's Impact

The Indian nuclear explosion of May 1974 had a major impact both in Argentina and Brazil. For some time these two countries had viewed each other's activities in the nuclear field with suspicion. After May 1974 it became a topic of common table talk among the elites of both countries to speculate about who would get the bomb first. Indeed, the Argentine magazine *Estrategia* praised India's peaceful nuclear explosion as showing "how an underdeveloped and technologically dependent country can attain objectives based exclusively on her own appreciation of the priorities of national defense" [22, p. 91]. The same article added:

The projections of Brazil's demographic growth place Argentina at a disadvantage that will tend to widen markedly over the next 30 years. Despite all the distortions of her growth, Brazil will become an important power, causing Argentina, if she does not adopt pertinent policies, to find it increasingly difficult to overcome Brazil or even maintain a situation of relative equilibrium... Argentina is, for the moment, ahead in nuclear technology. The Atucha power reactor, using natural uranium, is now operational and the project for the new reactor in Rio Tercero assures (Argentina) an advantage for at least the medium term .... Argentina and Brazil both are theoretically capable of producing an atomic bomb. This would mean, above all, a *political decision* [22. p. 91]. (Emphasis in original.)

The present nuclear rivalry of Brazil and Argentina dates from the early postwar period. Initially, Brazil supported U.S. efforts to control the development of atomic energy by secretly agreeing in 1945 to limit her thorium exports to consignees 'in the United States or . . . designated or approved by the United States" in return for annual U.S. purchases of specified amounts of thorium ore. However, Brazil's rivalry with Argentina soon led both countries to try to acquire technology developed in the unsuccessful German atom bomb project.

Shortly after the Argentine National Commission for Atomic Energy (CNEA) was formed in 1950, President Juan Peron appointed Ronald Richter, an emigré Austrian nuclear physicist who had done fusion research in Nazi Germany, as director of a new research facility on a remote island in a lake in southern Argentina. The facility was launched with considerable publicity 123].

Twenty months before the first U.S. thermonuclear hydrogen explosion, Peron gave a press conference to tell the world: "On February 16, 1951, in the atomic energy pilot plant on the island of Huemul, in San Carlos de Bariloche, thermonuclear reactions were carried out under controlled conditions on a technical scale." Peron then turned the press conference over to Richter who told the reporters: "I control the

explosion. I make it increase or diminish at my desire" [24]. Twenty months later Richter was suddenly fired and jailed when Argentine scientists found that he was experimenting with gas discharges using high-voltage capacitors, an activity not unrelated to fusion research but falling far short of his claims.

These strange experiments in the south of Argentina may have led to a much more serious effort by Br4ziI to obtain German nuclear technology during the postwar allied military occupation. In 1953, Admiral Alvaro Alberto, the first president of Brazil's National Research Council, visited Germany and met with Paul Haarteck, Otto Hahn and Wilhelm Groth, scientists who had played key roles in the abortive Nazi atom bomb project.

According to a recently published report, Groth, who pioneered the centrifugal enrichment process, told Admiral Alberto:

"Allocate the necessary funds and we will make the prototypes. Then we'll all go to Brazil and make the equipment there" [25].

A secret deal was made to ship three gas centrifuges for uranium enrichment to Brazil. Three Brazilian chemists were sent to Germany for special training in the handling of heavy gases, while Groth quietly ordered components from 14 different German factories. Alberto later told a parliamentary inquiry that "Germany was a country occupied by the victorious powers, and if it were discovered that they were planning to produce enriched uranium, this would lead to an international crisis" [26].

The secret was uncovered only when the centrifuges were ready for shipment. After the machines were seized on orders from James Conant. U.S. High Commissioner to Germany, the Brazilian government then turned to France in an attempt to obtain gaseous diffusion technology, again unsuccessfully. In a confidential memorandum to Brazil's National Security Council, the U.S. Embassy in Rio "frankly" observed that this "German adventure in Brazil . .. could be considered as a potential threat to the security of the United States and the Western Hemisphere"127]. The U.S. Embassy also urged Admiral Alberto's dismissal, warning that "the subject of atomic energy is and may continue to effect (sic) the political and economic relations between Brazil and the United States" [27]. Alberto, now a national hero and a pioneer of Brazil's shrewd policy of "specific compensation," trading natural resources for technology, resigned his post in frustration in 1955.

Argentina's Nuclear Program

The nuclear programs of Brazil and Argentina accelerated after 1955 when both countries signed agreements with the United States under the "Atoms for Peace" program, which made newly declassified scientific information available and provided for the training of nuclear scientists and technicians. While Brazil obtained her first research reactors under this program, Argentina steadfastly pursued an independent nuclear development policy to avoid international controls where possible and dependence on the virtual U.S. monopoly over supplies of enriched uranium.

With her own uranium reserves, a large pool of trained manpower and a relatively advanced industrial base, Argentina soon moved well ahead of other Latin American nations in developing a nuclear energy program. In 1958, Argentina became the first Latin American nation to operate a research reactor. In 1968, her CNEA began operating the region's first, and so far only, chemical processing plant—on a pilot scale—for reclaiming plutonium from spent reactor fuel. And in 1974, Argentina started up Latin America's first nuclear power plant [28].

"The CNEA in 1957 made a fundamental decision: not to import research reactors but to build them in Argentina," CNEA scientist Jorge Sabato wrote in a detailed account of Argentina's progress.

In this way would we not only have, in these reactors, a tool for training and research, but also their construction would also allow us to develop our own capacity for nuclear engineering. . .. In 1957, the CNEA also decided not to import fuels. These should be manufactured in Argentina, and so it (gradually) occurred. The development of our own nuclear engineering capacity was very important in the realization of our own feasibility study for Atucha-l (the 320-megawatt power plant, fueled with natural uranium that went into operation in 1974 near Buenos Aires) [29].

By the early 1970s, Argentina was operating six major centers for nuclear research and many of her scientists and engineers had received advanced training in the United States and Europe.

Argentina's nuclear program was developing so rapidly that the 12th Pugwash Conference meeting in the Soviet Union in 1969 was told that Argentina was mobilizing her physicists to produce nuclear weapons within 15 years [30].

The military implications of Argentina's decision to build the natural uranium power plant Atucha-I were not lost on the Brazilians. In December 1967 as Argentina's CNEA was preparing to announce its final decision on the design and contract for Atucha-I, Brazil's President Arthur da Costa e Silva (1967-1969) approved a National Security Council report recommending transfer of nuclear technology to our country; obtaining in the shortest time our independence in the production of nuclear fuels; creation of an infrastructure of support for the nuclear program and formation and training of teams competent in the different (specialized) areas [31].

In 1967 Brazil's National Council for Nuclear Energy (CN EN) commissioned a study of the feasibility of building an atom bomb, concluding that such a project, if attempted, would take 15 years 132].

Brazil's nuclear development had been slowed by a number of false starts. At the end of the 1 950s, President Juscelino Kubitschek (1955-1960) had decided on construction of a 150 to 200-megawatt power reactor using enriched uranium in the reactor design that dominates the nuclear power industry in the United States today, the light water reactor. Kubitschek, the founder of Brasilia, was succeeded by Janio Quadros. In 1961, the seven-month Quadros government, in developing its independent foreign policy, reversed these plans to opt for a natural uranium reactor along the lines of the first reactors then being developed in France. This project continued under Joao Goulart (1961-1964) as Brazilian technicians went to France for training and French nuclear engineers went to Brazil to begin preparations for construction of the reactor. However. this project was, in turn, cancelled by the military regime that seized power in 1964.

A few years later the French abandoned their efforts to develop a natural uranium reactor in favor of U.S. enriched uranium technology. Subsequently, Brazil seriously weighed the possibility of buying a Canadian Candu natural uranium reactor, the type which is to be used in Argentina's second nuclear power plant and the type which India used to "cook" the plutonium used in the 1974 explosion.

Brazil also has repeatedly asked We~iinghouse to help her develop a new technology to use her huge thorium reserves as reactor fuel, assisting the experiments of the Brazilian "Thorium Group" in BeIo Horizonte. Westinghouse, a contractor to the U.S. Navy's classified research program to develop a reactor based on the thorium fuel cycle, declined Brazil's request on the grounds that it could not commit the resources to develop thorium technology and because, as presently conceived, a power plant using thorium would need an initial charge of weapons-grade uranium and would not be economically competitive. Yet Brazil's quest for "self-sufficiency" has continued, through her 1972 contract with Westinghouse for her first nuclear power plant and, more importantly, through her giant deal with West Germany embracing the whole nuclear fuel cycle.

News of the Brazil-German deal has had such a psychological impact in the western hemisphere that its main political effect may have been achieved long before the final details of the complex agreement are worked out and construction begins in 1977-78 on the eight-year project to build the first two power plants.

The commanding general of the First Army in Rio de janeiro said the nuclear accord "constitutes a decisive step that reinforces the country's sovereignty," and he predicted that Brazil would "be transformed into a great power." Foreign Minister Silveira, after signing the agreement, said that "Brazil has gained new technological and political status on the world scene with the nuclear agreement," adding: "Both of our two countries must pray that nobody throws an atomic bomb at our heads while we are working at carrying out these agreements. Because we won't be the ones to throw it.''

Argentina's present inability to check Brazil's initiative in the nuclear field parallels her inability to counter Brazilian geopolitical initiatives in the interior of South America, and is easily understood in view of the political disorder that has escalated steadily over the past two decades in Argentina. Under these conditions, it is not surprising that Argentina's own nuclear program would be paralyzed, with her agreement to build a second natural uranium power plant, a Canadian Candu reactor, held up by her present financial difficulties [33].

In addition, many of Argentina's nuclear scientists have left the country. Many are working now in Brazil. The former head of CNEA, Admiral Oscar A. Quihillalt. is now serving in Iran as adviser to the Shah's atomic energy commission at a reported monthly salary of $10,000, assisted by seven other Argentine specialists.

In July 1975, the present head of CNEA visited Tripoli to sign a nuclear cooperation agreement between Argentina and Libya. At home, Argentina is engaged in an expansion of her pilot facilities for the reprocessing of spent fuels. With its impressive level of trained manpower and critical energy supplies, Argentina's capacity can only increase if the new regime stabilizes the country. An expanded nuclear program would have great symbolic value in such a comeback, and this could begin under the military regime that seized power in Buenos Aires in March 1975. The Argentine military's concern about the deal may be contained in *Estrategia's* admonition:

Given the available facts, *it is possible to affirm that (Brazil) has taken the firm decision to join the Nuclear Club, that is, to make an atom bomb under the concept of peaceful uses. . . the decision to manufacture the nuclear explosive and the opportunity, are critical for Argentina, since our neighbor's nuclear device, without a counterpoise, will affect our Security palpably and decidedly* [34]. (Eniphasis in original.)

U.S. Reaction

"If this agreement goes through at this time in this fashion, it will make a mockery of the Monroe Doctrine." *John 0. Pastore of Rhode Is/and, Chairman of the joint Congressional Committee on Atomic Energy, on the Senate floor june 3, 1975.*

The Senatorial thunder that greeted the news of the Brazil-German deal seemed to treat it as a kind of stab in the back from two of the closest postwar allies of the United States as well as one more sign of the erosion of US, power and influence. However, an outsider might have been surprised by the strange failure to foresee these developments by those statesmen who promoted "Atoms for Peace" and arranged for this torch to be passed from one generation to the next. In January 1976, David F. Lilienthal, the AEC's first chairman (1947-50), told the Senators that "we, the United States, our public agencies and our private manufacturers, have been and are the world's major proliferators."

Not only did the United States let the genie out of the bottle, but her salesmen have proselytized the genie's magic powers as a "safe and cheap" source of energy supplies. While the Soviet Union has been far more responsible and cautious in purveying the "peaceful uses" of atomic energy, the U.S. government has, in the words of a Brookings Institution study by Jerome Kahan "actively encouraged the sale abroad of U.S-built reactors by providing extensive technical assistance, attractive financing through the Export-Import Bank, and long-term supplies of enriched fuel at stable prices. During this period, foreign firms entered into licensing arrangements with U.S. firms in order to acquire the capability to produce reactors."

In view of the results of these policies we might well ask, with Mark Twain:

Shall we go on conferring our Civilization upon the peoples that sit in darkness, or shall we give those poor things a rest? Shall we bang right ahead in our oldtime, loud, pious way, and commit the new century to the game; or shall we sober up and sit down and think it over first?

There are problems ahead at every level—technical, strategic, political, and moral. Apart from the military potential of commercial nuclear power, the industry still must solve such problems as the long-term fuel shortage, safe disposal of large amounts of deadly radioactive waste materials, danger of terrorist theft of plutonium extracted from spent fuel, and rapid escalation of reactor construction costs.

As inflation and delay have raised the price of reactors from $300 per kilowatt of capacity in 1970 to $1,135 in 1975, the nuclear industry has been hit hard by recent cancellations of orders for at least 12 new power plants by U.S. utilities and postponement of 133 more. Consequently, there are pressures for increased government subsidies, which is a hallowed tradition in the nuclear industry throughout the world.

At the same time, enormous capital investments will be required for the next phases of development of the U.S. nuclear industry, anticipated for the late 1970s. These would be the expansion of enrichment capacity and large-scale separation of plutonium from spent fuel rods to obtain additional reactor fuel. These new phases of the industry's development involve physical as well as financial risks that are becoming the focus of intense political debate.

The Ford administration has proposed federal guarantees of up to $8 billion for construction of uranium enrichment plants by private industry. The leading candidate for a franchise and guarantee for commercial use of this highly classified technology, presently restricted to a government monopoly, is Uranium Enrichment Associates (UEA), a consortium organized by Bechtel of San Francisco, the world's largest private engineering firm and a specialist in construction of nuclear power plants.

In recent years Bechtel has hired two former Nixon cabinet members, George P. Shultz and Casper Weinberger, as well as Robert Hollingsworth, a former AEC general manager. Bechtel's salesmanship in the nuclear field led to one of the more picturesque diplomatic episodes to emerge from the Brazil-German deal. In April 1975 four State Department officials made a trip to Bonn, where they tried to persuade the Germans that enrichment technology should not be sold to Brazil because of the proliferation danger. Upon their return they learned that Bechtel had offered Brazil the same kind of technology two weeks before in a last-ditch effort to stop the German deal.

In view of the enormous government subsidies given, one way or another, to private nuclear energy companies in industrialized countries, the Brazil-German deal shows that "business-like" competition between these subsidized national companies really amounts to competition between the national governments themselves in a highly dangerous sphere of activity. Because of the military potential of the 'peaceful" uses of atomic energy, many developing countries are lured into ordering nuclear power plants they cannot afford, which will lead to heavy downstream losses for the already hard-pressed international reactor industry.

On the other hand, the desperate need to sell reactors will lead each manufacturer to satisfy clients' demands for "sweeteners" that can be used in weapons-making, such as enrichment and reprocessing plants. This will turn each sale into an act of political and diplomatic significance for the client and his neighbors. In effect, it may be regarded as a military alliance between buyer and seller, lasting at least as long— perhaps a decade or two—as the time needed for the facilities to be built and the manufacturer paid off.

In response to the Brazil-German deal, the United States proposed a standardization of the conditions of export sales of nuclear power plants. Foreigners viewed this initiative coolly. They saw it as a maneuver to deny them their first big chance of entering the international reactor business, and to preserve the commanding U.S. position in the field. At the "Secret Seven" meetings in London of supplier nations, the United States sought agreement on prohibition of the export of reprocessing plants, except under rigidly prescribed conditions.

However, U.S. sources later said that France and West Germany would agree only to consultations and safeguards inspection agreements before exporting sensitive equipment and materials. This would have the effect of fabricating a paper umbrella of unenforceable guarantees as a license to create a series of dangerous *de facto* situations throughout the world.

Who Owns the Technology?

Because the fuzzy economics of the nuclear industry stand in sharp contrast to the clarity of its military potential, it will become increasingly difficult to maintain the illusion that these companies can be run as a "business." More and more questions will be raised about the wisdom of parcelling out to competing sets of corporate executives a costly technology, developed at public expense, that owes its origin, and most proven use, to achievements in destruction and terror.

Apart from the bomb itself, the electricity-generating reactor was first developed for military purposes in the U.S. Navy's atomic submarine program. The submarine reactor was then "scaled up" to generate electricity commercially by Westinghouse and General Electric with research and development funds provided by the Atomic Energy Commission.

To the degree that further development of commercial nuclear energy is justified to prevent the collapse of industrial society, then much more rigid controls should be imposed to restrain the economic and military anomalies, which are in the nature of the beast, from getting out of hand. Rather than continue to stimulate "free" competition in the nuclear industry, it would be worth considering restructuring the international industry into a single cartel-consortium of producing governments using a standardized reactor technology to minimize diversion of materials for weapons purposes, licensing technology and exporting power plants only under the strictest non-proliferation controls. The standardization of reactor technology, in addition, could significantly reduce costs.

The centrifugal forces operating in the economy of the international nuclear energy industry, which have made it possible for Brazil to become a vessel of nuclear proliferation and Argentine scientists to become roving agents of the same process, can only be checked if governments assume direct responsibility for the industry. The salesman's vision of commercial nuclear energy as a boon to mankind and, hopefully, to corporate profits must be discarded in favor of a view of nuclear power as a dangerous but necessary devise to be used with great caution.

Since the U.S. government funded the research and development effort for commercial applications of nuclear power by American reactor manufacturers, who then transferred this technology under license to government-subsidized companies in Europe and Japan, these governments have a responsibility for the "business" of nuclear energy.

The developing countries singled out by disarmament specialists as being in the "near-nuclear" class and acquiring nuclear technology with clear military potential—South Korea, Taiwan, Brazil and Argentina—are the same ones to which the big U.S. and European private banks are most heavily over-committed with shaky loans. Not only does this imply a Western subsidy to these countries of the huge expense of acquiring nuclear power under very loose terms in the past and present. It also means, for the future, an important source of potential leverage for financial as well as technological restrictions on nuclear proliferation.

Disarmament specialists argue, with reason, that controls on "horizontal" nuclear proliferation need the moral sanction that can only be supplied by controls on the "vertical" proliferation of the nuclear arms race between the superpowers. However, as a practical matter, the present structure of the international nuclear industry still makes it possible for "horizontal" proliferation to be controlled by the Western governments themselves.

Curiously, while the moral claim of developing countries for access to "peaceful" nuclear technology has its main juridical support in Article IV of the Non-Proliferation Treaty, it is

the non-signers of the treaty, who have exhibited weapons-making intentions or capacity, that are benefiting most from transfers of "peaceful" nuclear technology, often under concessionary or giveaway financial terms.

The pressures to export nuclear technology are expected to escalate rapidly in coming years. Inflation, construction delays and the mounting impact of suspensions and cancellations of reactor orders are rapidly shrinking the home markets for nuclear power plants in the principal industrialized countries. In 1975 Westinghouse and General Electric each still had a share of the world market almost as large as all other producers combined. However, U.S. domestic orders for nuclear plants peaked in 1972-73.

Even before the suspensions and cancellations of the past year struck the industry, U.S. companies were capable of producing annually almost four times as many reactor pressure vessels and turbine-generator units as the United States would need in 1977. At this critical moment, Germany emerged as a major competitor in the international nuclear market. Looking over its shoulder to the expected entry of French, Swedish and Japanese competitors into the crowded and unstable world market, KWU is being driven to grab as many orders as it can before the competition becomes even more fierce and disorderly.

As an alternative to this, Senator Abraham Ribicoff has proposed "a cooperative arrangement with other suppliers, including France and West Germany," that would guarantee each supplier a minimum market share of reactor exports. Such an arrangement might be organized along the lines of Atomic Energy of Canada, Limited (AECL), the government company that acts as general contractor for the Candu reactor and parcels out business to the various component manufacturers.

While this might require the United States to yield a larger share of the international reactor market to other countries, it could bring the compensating advantage of heading off the kind of trade wars that could lead to nuclear wars. It could promote sharing of the financial burdens of such costly undertakings as enrichment, research and development, and the production of specialized components. It also could end the plague of "loss leader" giveaways of nuclear exports by establishing financial, technological and safeguards standards for all sales and by placing final control of these transactions in the hands of an international directorate run by governments—which is where the responsibility belongs. The reactor export industry should become an international public utility.

The fact that the international community has been able to stop the use of certain chemical and biological weapons for more than a half-century offers hope that concerted action can still manage the nuclear trade. Any additional cost incurred by this kind of management would be the price of peace. The failure to pay this price may mean infinitely greater costs further down the road.