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ARGENTINA'S NUCLEAR PROGRAM AND ITS IMPACT ON REGIONAL SECURITY INTERESTS

BY

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MAY 8, 1985

US ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013

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Argentina is among a growing number of Third World countries that has the capability to produce nuclear weapons. Several issues relevant to an examination of Argentina's nuclear program are its capabilities to manufacture nuclear weapons, its incentives or disincentives for choosing a weapons option, and the impact of a weapons option on its neighbors. The nuclear scientific and technical infrastructure that have been developed over the years, coupled with the growth and sophistication of its nuclear fuel cycle facilities, are

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evidence of Argentina's capabilities to manufacture nuclear weapons. Although Argentina declares its nuclear policy to be for strictly peaceful uses, it has sought to keep open its weapons option. There do not appear to be sufficient political and security motivations from any of its neighbors, notably Brazil, that would prompt Argentina to aggressively pursue nuclear weapons production. If Argentina were to make such a decision, Brazil could be expected to follow a similar option. While a nuclear arms race would be an eventual possibility, it would not necessarily impact unfavorably on the security interests of its regional neighbors, including the United States.

USAWC MILITARY STUDIES PROGRAM PAPER

ARGENTINA'S NUCLEAR PROGRAM AND ITS IMPACT ON REGIONAL SECURITY INTERESTS

An Individual Study Project

by

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Introduction

Nuclear energy programs for the generation of electrical power in the developing countries continue to be a controversial issue. Certainly this use of nuclear energy poses a number of challenging economic, political, and environmental problems. Consider the impact that the Three Mile Island nuclear accident in 1979 has had on the direction of nuclear power in the United States alone. The much larger concern of nuclear energy, of course, is its potential for nuclear weapons. Most observers will agree that the ability to produce nuclear weapons is inherent in nuclear power generation. The prospects of an increasing number of countries that are capable of procuring nuclear weapons over the next one to two decades is to many, of grave concern. Yet the nuclear capabilities of a country are not always telling of its intentions, hostile or otherwise.

The purpose of this research paper is to: provide a historical look at Argentina's nuclear energy program; discuss its nuclear capabilities; and finally, discuss its nuclear policy and the impact of this policy on the security interests of Latin America and the United States.

Most of the information used in the research for this paper was drawn from secondary sources. Some current information contained in the Daily Reports of the Foreign Broadcast Information Service proved useful; unfortunately time did not permit a more exhaustive use of this source.

OVERVIEW OF ARGENTINA'S NUCLEAR PROGRAM

The Beginnings

The first official acknowlegment by Argentina of the potential of nuclear energy came only one month after the United States detonated atomic weapons over Japan. Argentina's Presidency under its military leader, Edelmiro Farrell, "...proclaimed that the 'exceptional importance' of uranium affected 'the general interest of the nation', and that the use of the mineral 'for industrially applicable energy' could be foreseen within a relatively brief period."[1] Although there is no evidence that any appreciable nuclear research activities had been conducted immediately after the war, in 1949 President Juan Peron authorized laboratory facilities for nuclear energy research, with emphasis on nuclear fusion.[2] The facilities were constructed on an island on Lake Nahuel Huapi, near San Carlos Bariloche in northern Patagonia.[3] Peron selected Dr. Ronald Richter as the facility's director. Richter, a former Austrian physicist who had participated in Nazi Germany's nuclear fusion program, had emigrated to Argentina after World War II.[4] Argentina's first step toward the formalization of a national nuclear program--separate from the Bariloche laboratories--occurred in May 1950 when Peron decreed the creation of the Comision Nacional de Energia Atomica (CNEA, or National Atomic Energy Agency).

A rather dramatic and embarrassing episode early in the country's nuclear program took place in 1951. Peron and Richter called a press conference in which they announced to the world that

Argentina, through Richter's efforts, had mastered the process of controlling nuclear fusion. The scientific community worldwide began voicing its scepticism and soon afterward realized that the Richter's claim was nothing more than a hoax. Even scientists within the CNEA doubted Richter's claim. The episode was an embarrassment to Peron, and came at a time when he was facing mounting political problems. The CNEA was subsequently tasked to investigate Richter's work, and as a result, by late 1952 he and his staff were dismissed.[5]

Despite the Richter episode, Peron attempted to demonstrate Argentina's rightful place in nuclear technology by ordering CNEA to "hire qualified personnel, regardless of their political creed."[6] The policy of non-partisanship has largely remained a hallmark of the CNEA, and to a large extent contributed to the organization's successful development during its formative years.

Building the Foundations

In spite of a rather inauspicious beginning, one factor that contributed to the success of its nuclear program was that Argentina "...got a very early start."[7] In the beginning of the 1950's only a handful of countries--mostly the more developed ones--had even considered nuclear energy programs.[8] "It is noteworthy that Argentina created a national agency to shepherd the development of nuclear power at a time when even the most basic information about nuclear reactors was still highly classified in many nations."[9] The initial foundation-building period of Argentina's nuclear program began in 1952 when Navy

Captain Pedro Iraolagoitia succeeded Colonel Enrique Gonzalez as president of CNEA.[10] One of Iraolagoitia's primary goals was to hire competent personnel as a means of achieving "the first serious development of nuclear technology" for the nation.[11] Another goal was to establish a series of laboratories for research in cosmic radiation, elementary particles, nuclear spectrometry, isotope separation, and heavy water principles.

One of the CNEA's fundamental objectives that has remained the cornerstone of Argentina's nuclear program and its policies was to secure nuclear self-sufficiency.[12] As a first step, CNEA began a survey of the nation's uranium reserves to determine whether the country possessed sufficient quantities to make a long-range nuclear program possible.

With the knowledge that Argentina possessed substantial uranium resources, the CNEA addressed its next major objective of developing an infrastructure of scientists, technicians, and engineers.[13] Several specialized educational institutions and nuclear research centers were established, chief among them the Bariloche Atomic Center, located in the Andean resort of Bariloche.[14] There, in 1954, the CNEA founded the Dr. Jorge Balseiro Institute of Physics, which offered specialized studies in nuclear reactors, metallurgy, radioisotopes, and radiology.[15] As part of a massive effort to develop an infrastructure, a substantial number of foreign experts were imported to assist in training Argentine scientists.[16]

A further boost to Argentina's new nuclear program came from the

United States through the Eisenhower Administration's Atoms for Peace Program, initiated in 1953. As a result of a cooperative agreement between the two countries, Argentina received over the next few years training for several hundred of its scientists and $462,000 for nuclear power-related study and development.[17] Through the assistance of the former Atomic Energy Commission and the International Atomic Energy Agency, Argentina was able to assemble its first research reactor in 1958.[18]

The decade following Juan Peron's ouster in 1955 saw several reorganizations within CNEA, some of which provided it with more autonomy and greater emphasis on the scientific and industrial applications of nuclear energy.[19] Another theme of Argentina's nuclear development program in the post-1955 period was the strong emphasis on independence and self reliance in nearly every endeavor. For example, in 1957, a year before Argentina had assembled its first nuclear research reactor, CNEA rather boldly decreed that all future research reactors would be built in Argentina rather than be purchased abroad in order to provide Argentine builders and engineers with experience in nuclear reactor construction. One exception to the continued progress and growth of the CNEA infrastructure occurred during President Arturo Frondizi's administration (1956-1962). Frondizi's heavy-handed management of CNEA's top leaders coupled with his drastic reduction in CNEA's budget in 1960 led to some degree of organizational chaos, but Frondizi managed to extricate himself from the problem by reinstating the director of CNEA whom he had dismissed after becoming President.[20]

By 1964, CNEA was apparently sufficiently confident in its scientific expertise to undertake its own feasibility study for the country's first nuclear power plant. Three years later CNEA inaugurated a 10-year nuclear development program that was eventually extended to 1980.[21] It had as its "major goals...to complete three nuclear power stations, to install most of the facilities necessary for the manufacture...of nuclear fuel, and to stay abreast of world progress in plutonium reprocessing and breeder reactor technology."[22]

Toward An Independent Fuel Cycle

The period from 1967 to 1980 witnessed a number of successes for Argentina's nuclear program, but also included political turmoil which slowed somewhat the nearly uninterrupted record of progress up until 1967. The CNEA was successful in expanding its technical base to meet its objective of staying abreast of technology, as evidenced by its completion of a total of five research reactors by 1971.[23] Although CNEA undertook no activities in the breeder reactor field, a laboratory-size plutonium reprocessing facility was constructed..."yielding the first plutonium ever produced in Latin America."[24] In addition, CNEA made progress toward its goal of nuclear power plant construction by undertaking a feasibility study for its second plant.[25] According to some observers, CNEA did not fully attain its goal of manufacturing nuclear fuel. From the 1960's throughout the 1970's there were slippages in their plans to build uranium processing facilities and heavy water production plants.[26] Carlos Castro Madero, head of CNEA from 1976 to 1983,

contended, however, that during the period 1967 to 1976 uranium exploration was increased, the capacity of one uranium processing facility was increased, and two additional processing facilities were added.[27]

Perhaps the darkest period for the CNEA was during the second tenure of Juan Peron and that of his wife from 1973 to 1976. Peron had directed the CNEA to purge non-supporters and replace them with loyal Peronists, which had predictable disastrous results. His policy was a complete reversal of the nonpartisanship policy that he pressed for in CNEA during his first Presidency. One immediate result of Peron's policies was the departure of numerous talented nuclear scientists and technicians.

With the ouster of Isabel Peron in 1976 and the succession by Jorge Videla as Argentine President, CNEA was reorganized and Carlos Madero became CNEA president. Under Videla--and probably with substantial guidance from Madero--"two fundamental policy objectives" were instituted for the nation's nuclear development program. The first of these, which was intended to reverse the policies of the Perons, was to halt the "brain drain" and to develop an influx of qualified personnel.[28] One of the steps CNEA took was to establish a degree program in nuclear engineering at one of the national universities. The second policy objective called for the development of an industry to complete Argentina's nuclear fuel cycle, and develop a domestic capability to build its own nuclear power plants.[29] The Videla

regime acted as a catalyst in accelerating the nation's nuclear program toward nuclear autonomy and high technical competency. In addition, emphasis was placed upon nuclear cooperation with countries within the region as well as with states outside Latin America.

Nuclear Cooperation Efforts

Few analysts of Latin American affairs would dispute Argentina's expertise in nuclear technology on the South American continent. Even Brazil, whose nuclear program began at about the same time, has not matched Argentina's stature. Argentina can boast a number of firsts in Latin America in the nuclear area including the first research reactor and the first operational nuclear power reactor. Added to these are its achievements in associated nuclear industries including the region's first pilot-scale plant for chemical separation of uranium and the first pilot-scale plutonium reprocessing facility. More importantly, however, is the recognition by its neighbors that Argentina is a regional leader in nuclear technology and is capable of providing them with the nuclear technology they seek.

Regional Nuclear Cooperation. Argentina's first nuclear cooperation effort was with the United States in the early 1950s as part of the Atoms for Peace Program. Through a formal agreement, Argentina received training and grant aid. Growing political tension between Argentina and the US, however, effectively severed this cooperation as a result of US reluctance to provide needed heavy water for Argentina's first nuclear power plant and enriched uranium for its reactors.[30] Argentina was

particularly bitter toward US charges that it had been deceptive in removing plutonium laden waste from its power plant without informing the International Atomic Energy Agency.[31]

Beginning in the mid-1970s, Argentina signed bilateral nuclear cooperative agreements with Paraguay, Peru, Bolivia, Colombia, Chile, Ecuador, Uruguay, Venezuela, and Brazil. Some of these agreements were apparently intended merely to demonstrate good will among regional neighbors, but by the late 1970s the extent of Argentina's expertise in nuclear technology become apparent when it signed a second bilateral agreement with Peru. This agreement called for Argentina to design, construct, and operate an atomic research center based on an Argentine built, nuclear research reactor. The contract, estimated to be between $50 and 70 million, also called for construction of associated facilities for hydro-metallurgical processing of uranium ore, "a complete laboratory for processing radioisotopes for medical and agricultural use and scientific training."[32] This agreement also resulted in the formation of a joint nuclear agency between the two countries.[33] The Argentina-Uruguay agreement of 1979 was actually incorporated into two nuclear cooperation treaties signed in 1981. The first one called for Argentine construction of a research reactor and a proviso for training; the second called for Argentina to undertake a study to determine the feasibility of a large reactor for Uruguay.[34]

In May 1980 Argentina and Brazil signed a nuclear bilateral agreement, which many observers believed "...represented a

historic step toward more orderly and predictable bilateral relations, as well as a dampening of the two nations' long-standing nuclear rivalry."[35] This cooperative agreement included three stages. The first two stages, which were largely ceremonial, included a visit hosted by Argentine nuclear agency officials, followed by a reciprocal visit to Brazil. The third stage was substantive in nature and called for the joint Brazilian-West German company, NUCLEP, to fabricate the nuclear reactor vessel for the Atucha II power plant.[36] Also included in this agreement were provisions for exchanging technicians, training for specialized nuclear personnel, and information exchanges.[37]

Since at least the early 1980s Argentina's nuclear policy has placed increasing emphasis on exporting nuclear technology regionally. In early 1983 the CNEA head stated that "Argentina intends to present itself on the Latin American market as an exporter of nuclear technology."[38] To some extent the justification for achieving an independent fuel cycle is linked to its exporting ambitions. As stated by former CNEA head Castro Madero, "...Argentina seeks to become an exporter of nuclear technology..."[39] One observer points out that Argentina, with its natural uranium/heavy water technology, may, through its bilateral cooperation efforts in Latin America, be considered something of a "Latin American" natural uranium club...whereby those nations adopting the technology would be dependent on Argentina for nuclear equipment, uranium, and heavy water."[40] In 1983 Argentina initiated negotiations with Colombia, Paraguay,

Guatemala, and Chile for the sale of nuclear technology and equipment. The discussions with Colombia focused on the purchase of a uranium processing plant and a nuclear research facility with a small reactor.[41] The negotiations with Paraguay and Guatemala entailed supplying nuclear research centers.[42] In September 1983 Argentina and Chile ratified a bilateral agreement on the peaceful uses of nuclear energy which both countries had signed seven years before. Prior to the ratification, however, there had been exchanges of nuclear technicians.[43]

Besides the number of bilateral nuclear agreements it has, and continues to, negotiate with its regional neighbors, Argentina took the initiative in the mid-1970s, under CNEA leadership, to develop a coordinating group on nuclear energy. The group, referred to as Reunion de Autoridades Nucleares de America Latina, or RANDAL for short, consisted of 16 Latin American countries which are members of the International Atomic Energy Agency.[44] This group established as its goals to promote "cooperation among Latin American nations in the use of nuclear energy, and to take maximum advantage of available international support for nuclear energy development..."[45]

Extra-regional Cooperation. Argentina's nuclear relationships extend to Europe, the Middle East, and Asia. Argentina's closest nuclear cooperation has, to date, been with the West Germans. The first such efforts, which were within the industrial sector, involved the contract for Argentina's first power reactor in the 1960s, and its third power reactor in the 1970s. West German nuclear firms were very obliging in their willingness to transfer

the nuclear technology that Argentina eagerly sought to build its own scientific and technical infrastructure. One of the most recent events providing additional evidence of the closeness of Argentine-West German cooperation was the pact signed with Kraftwerk Union (KWU) in which CNEA would act as the Union's Latin American representative. "Under this agreement, CNEA is authorized to undertake exports of nuclear" equipment designed by KWU."[46]

In addition to Argentina's close relationship with West Germany in the nuclear area, it has, or is conducting negotiations for bilateral cooperation agreements with India, Libya, Iran, South Korea, France, Italy, Turkey, and Egypt.[47] Cooperation efforts with India were initiated almost immediately after India's explosion of its so-called 'peaceful' nuclear device. The two countries signed a five-year agreement providing for joint research projects and an exchange of scientists and information.[48] There was a great deal of concern in the United States that the commonalities in the Indian and Argentine nuclear programs were an indication that Argentina would explode its own nuclear device. The most obvious commonality was that both progrems were based on natural uranium reactors.[49] And such reactors are more efficient producers of plutonium--one of the materials used for nuclear devices--than those fuelled with slightly enriched uranium.

Argentina's bilateral relationships outside Latin America have also included the Soviet Union and the Peoples Republic of China

(PRC). In the early 1980s the Argentines purchased from the Soviet Union heavy water for their power reactors, limited quantities of enriched uranium for their research reactors, and manufacturing equipment for their fuel fabrication facilities.[50] In August 1984, Argentina hosted a delegation of nuclear scientists, technicians, and government officials from the PRC.[51] The visit included tours of various Argentine facilities, and talks were held with Argentine nuclear personnel to exchange information in an effort to foster technological and economic cooperation.[52]

Recent Economic Problems

The energetic--perhaps overly ambitious--long-range, nuclear development plans envisaged by the CNEA in the latter 1970s began encountering economic difficulties as Argentina's financial situation began deteriorating. By the end of 1983 Argentina's total foreign debt amounted to $44.4 billion. Further, the nation is among the leaders in its inflation rate, standing at an annual average of 335 percent. The severity of the country's financial problems has impacted directly on the nuclear program. Up until this time the nuclear program had generally been insulated from the normal budget constraints imposed on other governmental agencies. For the first time the CNEA budget is facing very serious cuts; its budget for 1984 which had been tentatively approved for $700 million was cut to $250 million.[53] Similarly, the 1985 CNEA budget has already been trimmed from $500 to 400 million, and will likely be cut further before being enacted.[54] One reporter observed the "the economic situation of

the Argentine nuclear program during 1984 was characterized by a budget cut that practically strangled the program, causing the paralyzation of almost all construction [and] the postponment of planned projects."[55] There have been delays among several construction projects associated with the nuclear fuel cycle. Construction plans for an indigenous uranium conversion plant have been delayed at least a year, as well as delays in plans for an industrial-scale fuel element fabrication plant. Further, the plutonium reprocessing facility being constructed at the Ezeiza Atomic Center, which had originally been scheduled for mid-1982, has been pushed back to at least 1986. Financial problems also threaten to halt work on the Pilcaniyeu uranium enrichment plant.[56]

Delays in the nuclear fuel cycle projects have been paralleled with similar problems in ongoing and planned nuclear power plant projects. There have been work slowdowns and stoppages on the Atucha II project, and some suppliers for the project have discontinued material because the Argentine government has been unable to consistently meet its contract payments. Another negative effect of the financial problem for the CNEA has been the renewed drain of human resources. The agency has had to prioritize its projects in the face of shrinking budgets and has contemplated reducing manpower on selected projects.[57] According to one observer of Argentine technical issues, the prospect of continued budget constraints for CNEA would inevitably lead to an "exodus of scientists and technicians...and the shutdown of private enterprises that had developed a high degree of

competence in engineering, construction, material, and equipment in the nuclear area."[58]

Until the recent onset of economic problems, Argentina's nuclear program has generally enjoyed uninterrupted growth, not only in size, but in the degree of its sophistication and expertise. There are several factors that have accounted for this success. The first and probably the most important factor, has been the CNEA. According to Daniel Poneman, "...CNEA achieved a level of stability perhaps unparalleled in the Argentine government."[59] Chairmen of the CNEA have tended to remain in authority for a long time. Admiral Quihillat chaired the commission from 1955 to 1973, and Castro Madero from 1976 to the end of 1983. In addition, the CNEA has consistently sought highly qualified people. Some of the purges of intellectual institutions by Peron in the early 1950s created a large pool of unemployed talented people of which the CNEA hired many.[60] The result of sound hiring practices led to good management practices, which in turn "reinforced stability" within CNEA.[61] Poneman contends that the stability realized by CNEA is what has given it the "bureaucratic clout to protect its highest priorities.[62]

Despite the periodic disruptions, one of the central features of Argentina's nuclear program has been continuity. "The single most outstanding characteristic of the Argentine program is that "it...has shown a consistency of purpose in nuclear policy unusual for a Third World nation...Argentina has never been interrupted by bureaucratic infighting and indecision or by intra-governmental rivalries, which seem to be so common in

nations struggling with the problem of how to best allocate scarce resources."[63]

Another underlying factor accounting for the success of Argentina's nuclear program has been the existence of a well developed industrial base and infrastructure, as a result of the industrialization the country has undergone in the late nineteenth and early twentieth centuries.[64] What has allowed the Argentine nuclear industry to build upon and to specialize has been the insistence of CNEA to promote local, that is, Argentine participation in its multinational nuclear projects. A third factor has been the technical assistance that Argentina has continually sought throughout its program--assistance that, in turn, it has used to build its own scientific and technical infrastructure. West Germany has historically assisted Argentina in realizing this objective. The contracts for the Atucha I and II power plants and the industrial-scale heavy water plant both have called for high levels of technology transfer and assistance to Argentina. West German private industry has gone to great lengths to assist Argentinian technical capabilities in the nuclear power industry. For example, Kraftwerk Union (KWU), which is under contract for the Atucha II plant, scheduled Argentine engineers to spend from six to 18 months in KWU project groups in West Germany in order to provide them with the necessary on-the-job training in technical areas and project management practices.[65]

ARGENTINA'S NUCLEAR CAPABILITIES

Uranium Resources

One of the underlying factors in Argentina's decision to pursue the development of nuclear energy was its substantial uranium resources. One source ranked Argentina as eighth in the world in terms of cheap uranium reserves, that is reserves that can be extracted at less than $10 per pound of uranium oxide.[66] While it may be an oversimplification to state that Argentina's realization of its uranium potential led directly to a nuclear development program, the existence of abundant uranium ore was a persuasive economic argument for its program. Estimates of Argentina's uranium reserves have varied over the years, in part due to the inaccuracies of making such estimates, but also because there have been additional discoveries of uranium deposits. According to a 1975 International Atomic Energy Agency report Argentina's reasonably assured resources of uranium ore concentrate were estimated to be 3,800 tons in 1965, but had risen to 9,700 tons a decade later.[67] Argentina's additional uranium resources (uranium ore concentrate that is somewhat more expensive to mine) were estimated to be 12,000 tons in 1965 and 15,000 tons by 1975.[68] By way of comparison, the reasonably assured uranium reserves of the US in the 1970s were estimated to be 250,000 tons. The aforementioned estimates for Argentina appear to be conservative compared to those reported by Carlos Castro Madero 1982. According to Madero, "reasonably assured reserves during the period from 1967 to 1976 totaled 25,000 tons of ore concentrate..."[69]

In addition to the differences noted in Argentina's estimated uranium reserves, there are also differences in the estimates of how long the uranium reserves will last given the demand. Carlos Madero stated that "an evaluation of Argentina's uranium reserves has suggested that...supplies will not last beyond the first decades of the next century."[70] Given Madero's position as the head of the CNEA at the time he made the statement, one would assume his estimate to be accurate. Other estimates do seem more optimistic, however. One calls for sufficient uranium to fuel up to eight operational and planned power nuclear reactors "well into the twenty-first century."[71] From the latter 1960s through the mid-1970s, uranium exploration was intensified.[72] And more recently the Argentine government has placed a high priority on uranium mining. In 1985, for instance, plans call for surveying upwards of 100,000 square kilometers of potential uranium bearing territories.[73]

Uranium mining in Argentina is conducted near Don Otto and La Rioja in the northwestern region and San Luis in the central region. The newest uranium discovery, at Sierra Pintada in the east central region, began operations in 1983.[74] The Argentinians have been mining and processing uranium since the early 1950s. By the late 1960s, the annual production of uranium concentrate had reached nearly 50 tons, and by 1970 production totalled about 55 tons.[75] Concentrate production in the early 1970s had fallen off; in 1975 it was just under 44 tons.[76] By the early 1980s production had jumped enormously, mostly in response to the fuel demands of their two operational nuclear

power reactors. The 1982 production rate was between 180 and 220 tons.[77] Facilities constructed for processing uranium ore include a uranium mill at Marlargue, in the east central region, and a heap-leaching plant for uranium ore at Don Otto. Over the next nine years the capacity of the Marlargue mill was tripled, a second heap-leaching plant was constructed at Los Adobes, in the southern province of Chubut, and a purification plant for uranium concentrate, loceted about 300 kilometers northwest of Buenos Aires, began operations.[78]

Nuclear Research Reactors

An important ingredient of Argentina's nuclear program has been its nuclear research reactors. Much of the theoretical and applied research necessary for the training of Argentina's nuclear scientists and technicians is conducted at research centers colocated with these reactors. At the present time Argentina has six operational reactors, of which the newest one, RA-6, was inaugurated in 1982. Argentina's first nuclear research reactor, RA-1, was built by Argentine scientists from components manufactured indigenously, using plans provided by the US National Argonne Laboratories.[79] The remaining five research reactors were constructed solely by plans developed by Argentinian scientific and technical expertise.[80] It is the RA-1 research reactor which not only served as an important training tool for nuclear scientists, but also provided the radioisotopes for Argentine medical research.[81] All six research reactors operate on enriched uranium fuel, which until 1978, was supplied by the US.[82]

Nuclear Power Plants

Argentina currently has two nuclear electrical power plants in operation, and a third plant is under construction. The older of the two operational plants, referred to as Atucha I, is located 10 kilometers northwest of Buenos Aires in the Atucha landmark on the west side of the Rio Parana de las Palmas River. The other operational plant is located on Lake Rio Tercero at Embalse near Cordoba approximately 600 kilometers northwest of Buenos Aires. The plant currently being constructed, Atucha II, is located on the same site as Atucha I.

Atucha I. One of the first steps taken by Argentina in its pursuit of a nuclear power plant was a feasibility study. The study itself was developed by the CNEA and was focused on the Greater Buenos Aires area. Unlike a number of developing countries that contract for nuclear power and rely on the expertise of the foreign contractors, CNEA decided to do the study indigenously.[83] Several factors apparently led to CNEA's decision; the first was to allow Argentine technicians, scientists, and engineers to gain experience in the planning area; another was to demonstrate to foreigners that Argentina had the wherewithal to accomplish such a study.[84] Additionally, the CNEA undertook the study themselves in order to control the outcome, and thus avoid any criticism.[85] The major conclusions noted in the study were that a) the electrical network of the Buenos Aires area was sufficiently large to accommodate a nuclear power station, b) such a power station could be completed and

operational in seven years, and c) Argentine industry would be able to participate in roughly one half of the power plant's construction and operation.[86] The issue of local participation apparently was a result of CNEA's recognition and commitment to a 1963 decree, referred to as the Argentine purchase law, which required that preference be given to Argentine goods over imported goods in purchasing considerations.[87] It should also be pointed out that the existence of abundant native uranium reserves was no inconsequential factor in the favorable conclusions reached by the CNEA study. Quite simply, the "adequacy of indigenous uranium resources added to the appeal of nuclear power."[88]

Given CNEA's conclusion "...that it was 'technically feasible, economically convenient, and financially sound'..." to construct a nuclear power plant in the Buenos Aires... area, the next major issue confronting CNEA was the type of nuclear reactor.[89] Apparently economic and political factors dominated this decision. Economically, a heavy water reactor was the better choice, given Argentina's uranium deposits. Light water reactors use slightly enriched uranium as the fuel, and because the United States was the sole supplier of enriched uranium at the time of the first Argentine power plant project, the "...zealously independent Argentinians looked askance upon direct dependence upon their North American neighbors."[90]

Despite the certain attraction of heavy water reactors, CNEA did solicit bids for light water reactors from British and US suppliers. One observer noted that CNEA was interested in a

light water reactor for two reasons. First, this reactor type is less expensive than a heavy water reactor and even though CNEA preferred independence, cost was still a factor. Second, by encouraging more bids, the competition could result in better terms for Argentina.[91] The two finalists for the Atucha I contract were Siemens Aktiengesellschaft (Siemens AG) of Erlange, West Germany, and Atomic Energy of Canada Limited (AECL). Of interest is the fact that the British also submitted a bid for a natural uranium reactor, believed to be better than the one proposed by Siemens.[92] Apparently the Argentines rejected the British offer in retaliation to a British boycott of Argentine beef, in effect at approximately the same time the decision was made.[93] The German bid offered the best deal in terms of Argentina's participation in the project (35 percent), the 100 percent financing of the project, and the shortest delivery time. The biggest problem with the Siemen's offer was its lack of experience with large natural uranium reactors. By comparison, the heavy water reactor offered by the Canadians was believed to be better engineered, the reactor size being considered had been extensively tested, and there was greater potential for transferring the reactor technology to the Argentinians.[94]

Despite the above-mentioned advantages and disadvantages, the Atucha I project was awarded to Siemens AG.[95] Additional factors that probably influenced CNEA's decision were the longstanding commercial ties that West Germany had with Argentina, and the good reputation of the Siemens industry.[96] The price tag for Atucha I was initially $70 million, but with cost overruns the

final total was $140 million.[97]

Excavation work on Atucha I power plant began in June 1968. The construction schedule slipped nearly three years due to problems with the steem supply system and the fuel rod support system.[98] Finally, in March, 1974, Atucha I began delivering electrical power to the greater Buenos Aires area. Despite the problems noted during construction, Atucha I has functioned very efficiently since it began operation, having consistently operated at over 90 percent capacity.[99]

Embalse. Argentina's decision to undertake construction of its second nuclear power plant was but one facet of a broad nuclear program which the CNEA adopted in 1967. One of the three goals outlined in this extended ten-year plan was the completion of three nuclear power plants.[100] Like the approach taken by the CNEA with the Atucha I plant, a feasibility study was initiated for the Embalse project, but it was not until five years later that the CNEA was given the authority to solicit bids. The lengthy period from the start of the feasibility study until contract bidding began was apparently not associated with technical concerns associated with the study findings. Rather it was as result of three changes in Argentine presidents and the accompanying turbulence in government policies.

As bidding for the Embalse project began, so did the issue of reactor type. A number of observers as well as potential players within the nuclear construction industry saw the outcome of the Argentina decision on the reactor type for the Embalse project as

an indication of "...the government's final choice of a reactor type.." for its overall nuclear power plant program."[101] Despite the Argentinians' continued strong interest in natural-uranium reactors, the arguments for an enriched uranium reactor appeared to be more convincing. Almost surprisingly the West Germans who had strongly advocated heavy water reactor technology for the Atucha I plant not only did not offer a heavy water reactor, but "...tried to convince CNEA...that they should go to..." light water technology.[102]

As pointed out by one observer, "The Argentine priority on independence could no longer justify automatic preference for heavy water reactors."[103] The Canadians, who had bid their heavy water reactor technology for Atucha I were the only vendor pursuing this technology for the Embalse project. Heavy water reactors meant dependence upon the Canadians, and thus "dependence upon foreign enriched uranium suppliers would be traded for dependence upon foreign heavy water supplies.[104] The issue of Argentine dependence upon American supplies of enriched uranium for fuel were no longer valid. The monopoly on enriched uranium held by the US was approaching an end at about the time of the Embalse bids. Several European consortiums, such as the French, were to soon complete uranium enrichment facilities.[107]

Aside from the dependency issue, which in itself added to the argument for light water reactors, the issue of cost differential also favored light water technology. Because of their simpler design, light water reactors are cheaper to build than heavy

water reactors. These factors considered alone would have favored a light water reactor for Embalse, yet the contract was awarded to a consortium of Atomic Energy of Canada Limited and the Italian electrical manufacturer, Italimpianti(AECL-IT).[106] A factor that probably heavily influenced the decision to opt for AECL-IT was the supplemental technology transfer agreement, which was considered by CNEA to be a valuable step "toward independence in nuclear power production."[107]

The Canadian-Argentine contract for Embalse caused a number of frustrations and problems for both countries. First, the original cost of the contract was $250 million, but by completion, the price had reached $1.25 billion. During constuction, Argentina was still entrenched in political turmoil. The resulting economic problems led to AECL-IT's substantial losses. Renegotiation of the financing for the Embalse project was required on more than one occasion and these deliberations took considerable time. Another major issue for the Canadians related to nuclear safeguards. The plutonium used in building the nuclear device detonated by India in 1974 came from a research reactor that the Canadians had provided to India. In order to avoid any possibility of a similar incident, Canada insisted that Argentina accept safeguards on the Embalse plant to ensure that nuclear material would not be used for nuclear explosives. Reluctantly the Argentines agreed not to re-export any technology or materials produced in the Embalse reactor for any type of nuclear explosive.[108] Finally, in an attempt to curtail its involvement in the Embalse project, Canada decided against

providing the technology transfer agreed to in the initial contract. From Argentina's standpoint, Canada's decision not to abide by the transfer agreement would have a substantial impact on the development of Argentina's nuclear technological base and " which the CNEA considered as a valuable stepping stone toward independence in nuclear power production."[109] Despite its problems, the Embalse plant finally began operation in March 1983.

Atucha II. Planning for Argentina's third nuclear power plant also began during a period of political and economic turmoil. Although the 1967 ten-year plan had called for the completion of three nuclear power plants, it was not until 1976 that plans for Atucha II came to fruition. In an attempt to limit construction costs for this plant, a decision was made to locate it near the already prepared Atucha I plant site.[110] In 1978, the CNEA finalized negotiations for building Atucha II, and studies were submitted by Atomic Energy of Canada (AECL) and Kraftwerk Union (KWU), a subsidiary of Siemens AG.[111]

Because of the problems encountered with Canada on the Embalse project, including Canada's insistence on nuclear safeguards for any future Canadian assisted projects, Argentina decided on KWU's natural uranium reactor. The contract was actually split between KWU which would provide the reactor and the Swiss firm of Sulzer Brothers, which would build a heavy water production plant. Besides the safeguards issue, several other factors led to the Argentine decision to buy German. The reactor proposed by KWU was apparently more compatible with Argentina's needs than the

one offered by Canada. Additionally, the KWU reactor would be compatible in its design with the existing reactor at the nearby Atucha I plant. Finally, as viewed by the CNEA, the arrangement with the Germans offered "a diversification of suppliers that Argentina felt would give it greater freedom and autonomy..."[112] The contract with the German and Swiss firms was much less encumbering from the standpoint of nuclear safeguards than was the Canadian offer.

In addition to the contracts related directly to the construction of Atucha II, there were several supplemental contracts providing for Argentina's participation.[113] One of the contracts called for CNEA to produce some of the fuel elements and heavy water for the Atucha II reactor, and for other Argentine sources to fabricate nearly 50 percent of the ancillary components and systems for the reactor.[114] Further, the supplemental contracts called for the establishment of a joint German-Argentine company called Empresa Nuclear Argentina de Centrales Electricas (ENACE).[115] The purpose of this company is to provide engineering services, and in conjunction with other Argentine companies, and provide specialized manufacturing in order to promote Argentine industrial development.[116] Originally scheduled for operation in 1987, projected startup of Atucha II has slipped two years to 1989.[117]

Planned Nuclear Power Plants. One of Argentina's long term goals is to become totally self-sufficient in energy, and it has been but one aspect of the nationalistic drive for their independence

of action. The availability of energy is a basic requirement for most developing nations in their struggle to achieve economic progress, and for Argentina economic progress could be viewed as independence from the industrialized Western nations, particularly the United States. It is not surprising that the emerging Argentine nuclear program, under CNEA direction, has historically had an ambitious outlook for the important role of nuclear energy in meeting the nation's energy needs. Perhaps the most ambitious plans for additional nuclear power plants were outlined in a paper presented in 1971 to the 4th United Nations Conference on the Peaceful Uses of Nuclear Energy. This paper projected "a nuclear generating capacity of 30,000 megawatts (30 percent of the total) by the year 2000."[118] By 1976, at the time when bidding was under way for the Atucha II plant, however, the number of planned nuclear plants had declined somewhat. Plans were developed for the completion by 1985 of six [additional nuclear] power plants, with a total capacity of 3,700 megawatts.[119] In view of the three-year slippage in completing Atucha I and the problems that were already beginning to plague the Embalse project, the likelihood of completing six more plants within nine years should have appeared unrealistic to the CNEA planners.

Just two years later, there were indications of a further reduction in the number of planned nuclear power plants. The government accepted for approval a plan to build four rather than six additional plants over a 20-year period.[120] More recent projections for plant construction, through the year 2000, call

for only three 600-megawatt plants.[121] The first of the three is to be located at Cuyo, in Mendoza Province. A feasibility study for this project has already begun, and according to one source, it is scheduled for operation in 1991.[122] The specific locations for the fifth and sixth power plants have not yet been decided, although one is slated for the northwestern region and the other for the southern part of Buenos Aires Province. Both are scheduled for operation in 1997.[123] The expected cost for all three plants is estimated at $5 billion.[124]

Nuclear Fuel Cycle Facilities

Since the mid-1970s Argentina has been striving to develop an independent nuclear fuel cycle based on natural uranium. Their fuel cycle activities include uranium mining and conversion, fuel element fabrication, heavy water production, uranium enrichment, and plutonium reprocessing. Several ancillary activities associated with Argentina's fuel cycle include zirconium and zircaloy production, spent fuel storage, and plans for nuclear waste disposal.

Argentina's uranium mining and conversion activities were discussed earlier in this paper under 'Uranium Resources'.

Fuel Element Fabrication. In 1976, two years after Atucha I became operational, manufacturing of reactor fuel elements began at a pilot plant located at Constituyentes, northwest of Buenos Aires.[125] Current plans call for fuel element production to be moved to the Ezeiza Atomic Center, where a production-scale plant, was initially scheduled to begin operations in the early

1980s. The Argentinians are also engaged in zirconium and zircaloy production, an industry closely associated with fuel fabrication. Zirconium is the basic metal for the production of the alloy, zircaloy, which in turn, is used in tubular form to encase uranium fuel elements for reactor use. The Argentinians apparently developed the know-how for this process from the West Germans.[166] Currently a pilot production plant with a one-ton-per-year capability is located a Bariloche. This plant, in operation since 1978, produces an intermediate material called zirconium sponge, which is further processed into zircaloy.[127] A new plant for producing zirconium metal from indigenous sources or imports is planned at Pilcaniyeu, in Rio Negro Province.[128] In addition, an alloys factory for producing zircaloy has already been built and a full-scale zircaloy tube plant is under construction.[129]

Heavy Water Production. Heavy water is a basic ingredient for Argentina's natural uranium nuclear power reactors. It serves as the heat transfer medium in the nuclear fission process for steam generation and as the moderator for the fission process itself. According to a 1979 report written by the then head of CNEA, a pilot version of a heavy water plant, with a two-ton annual capacity was expected to be operational in 1983.[130] Construction of this plant, which was more than 60 percent complete in 1983, has been delayed.[131] This plant was to be the model for the construction of an Argentine-designed, 250-ton plant, under construction near the Atucha power plants.[132] The contract also included construction of a 250-ton heavy water plant by the Swiss

firm of Sulzer Brothers. The plant, located at Arroyito, in Neuquen Province, was scheduled to begin operation in late 1984.[133]

Uranium Enrichment. Announcement of the construction of a uranium enrichment plant by the Argentinians in 1984 was yet another indication of their effort to achieve nuclear independence. The uranium enrichment plant, currently under construction, is near Pilcaniyeu.[134] A number of critics have assailed the enrichment plant as unnecessary, given Argentina's reliance on natural rather than enriched uranium to fuel their power reactors. But, on the other hand, not only can enriched uranium can be 'burned' in a natural uranium reactor, but it 'burns' at a higher efficiency. Indigenously produced enriched uranium would also provide fuel independence for their six research reactors. After uranium fuel elements have been expended inside a power reactor, they are placed in specialized storage facilities to protect the environment against radiation hazards. Such storage facilities provide a temporary holding area prior to reprocessing. Argentina currently has two spent fuel storage areas, both of which are located at Atucha. The first became operational at about the same time Atucha I became operational. The second storage facility, also completed, began operations in mid-1982.

Plutonium Reprocessing. Plutonium reprocessing is the method for separating the plutonium produced as a by-product of the uranium fission process. The process requires stringent safety procedures, given the high radioactivity and toxicity of plutonium and the fission by-products. Argentina developed its

plutonium separation technology in 1967, and an experimental laboratory-size facility for advancing reprocessing technology was constructed near Constituyentes.[135] This laboratory was subsequently dismantled in 1977, and was followed by plans for a pilot reprocessing plant at Ezeiza. The original schedule called for operations to begin in mid-1984.[136]

Nuclear Waste Disposal. A significant problem of the nuclear power industry continues to be the safe storage of considerable amount of radioactive waste produced in a nuclear reactor. Like all of the countries possessing nuclear power plants, Argentina has undertaken efforts to provide suitable nuclear waste disposal. In 1983-1984, a field study began to search for a suitable underground geological storage site at Sierra de Media, in Chubut Province.[137]

ARGENTINA'S NUCLEAR POLICY

In general, developing countries that are seeking, or already have, nuclear power programs --according to Daniel Poneman--can be divided into one of two groups. One group is primarily interested in seeking "...nuclear-generated electricity quickly," and this group normally can be expected to "...accede to binding pledges against the acquisition of nuclear weapons."[138] By acceding to pledges of nonproliferation, does not imply that these nations are unaware of security consideretions or the perceived ramifications of pursuing a nuclear weapons program; instead they do so in order not to alarm those nations who supply them with nuclear hardware and technology. Countries that fall

into this group include Mexico, South Korea, and Egypt. The other group, in contrast, places a high priority on the "...security benefits that nuclear technology affords; [they] seek to acquire sensitive nuclear technologies...and will usually sacrifice the economic benefits of nuclear-electric generation in order to preserve their independence."[139] India, Israel, Pakistan, South Africa, as well as Argentina pursue an 'independent' policy.[140]

Political Motivations.

In examining the political motivations underlying Argentina's nuclear program, one could argue that politics was the dominant factor at its outset. Poneman contends that "political motivations anchored the original Argentine nuclear commitment."[141] The Richter episode in 1951 has been viewed by some as a political ploy by Peron to defer attention from his growing political problems, and as a means to bolster his reelection chances. Others maintain that Argentina's motives for nuclear power "can be summarized under the general rubric of nationalism and the desire to establish nuclear autonomy. Achieving domestic self-sufficiency in atomic energy has been portrayed as a necessary condition for national pride. Many analysts believe that Argentina has always had ambitions of being a major international power; and nuclear energy was often promoted with the claim that it could provide them with the means of achieving great power. This theme of great power status has been an enduring one, for "...[its] desire to have a major part in the global community was not merely a Peronist phenomenon,

isolated to the period of his leadership... The...government has always regarded [itself] as the major cultural, economic, and political center of Latin America..."[142] Clearly the development of nuclear energy was viewed by the Argentine government as a striking demonstration of its technical ability and thus its leadership. The fact that Argentina has recently become a nuclear supplier is undoubtedly a source of enormous satisfaction for them. No other Latin American country can boast such extensive nuclear cooperation with its neighbors as Argentina. Argentina today remains the only developing country that has ever exported a nuclear reactor.

Security Motivations

Another consideration or motivation in the molding of Argentina's nuclear power policy has been security. A sizable amount of the literature dealing with nuclear issues in Latin America focuses on security simply because of its linkage with nuclear weapons. For the purposes of this paper, security is defined simply as the need of a country to defend itself. Some analysts argue that Argentina's rivalry with Brazil has been the underlying factor that has driven Argentina's nuclear power program. The relevant question, however, is whether this rivalry has been sufficient to cause Argentina, to pursue a nuclear weapons program. Some view this rivalry as especially bitter, as indicated by the following: "Their [Brazil and Argentina] competition is reflected in the not uncommon Argentine sentiment that 'the natural enemy of all Hispanic-American nations is Brazil....Brazil forms a foreign element within our body. Such views are abetted by traditional

Brazilian claims to manifest destiny..."[143] Early in this century one Brazilian concluded that "the historic and political superiority of Brazil is manifest, united, colossal, irreducible...It is destined to occupy in South America...the same preponderant place that the United State occupies in North America."[144] The school of thought that views a high level of rivalry between the two countries offers as evidence the significant quantitative disparities in Brazilian-Argentine military capabilities. For instance, by the latter 1970s Brazil had 81 percent more military personnel than Argentina, and with a 55 percent higher military expenditure-to-troop ratio."[145] Further, "...Brazil seems to be pursuing a more vigorous procurement program, is obtaining a sizable and relatively sophisticated defense industry, and has become an arms exporter..."[146] Continuing with the logic of this argument, Argentina's military capabilities would fall further behind Brazil's, and it must either accept its diminishing power and influence or seek means to offset Brazil's advantage. Thus, "...the issue is whether nuclear weapons would provide a military counterbalance to Brazil's superior...forces."[147] The other school of thought which, while acknowledging a rivalry of sorts between Argentina and Brazil, contends that the friction is an indirect one--aimed primarily at competition for influence on the smaller regional states.[148] Given that the level of friction between the two has remained low, "...a major direct confrontation between both countries is unthinkable in the foreseeable future.[149] Further evidence of the low intensity

level of the rivalry between the two countries is the lack of military forces massed long the boundaries separating them.

In assessing Argentina's nuclear policy, there have been a number of indicators or signals that appear, on the one hand, to suppport a nuclear weapons option. One of the stronger pro-nuclear weapons signals given by Argentina (as perceived by a number of observers) has been its pursuit of sensitive nuclear technologies--that is technologies that lend themselves to nuclear weapons. Two events that have attracted the most attention are Argentina's announcement of its development of a uranium enrichment process, and the production of plutonium through the chemical reprocessing of spent fuel rods from their nuclear power reactors. Although both processes can be used for peaceful purposes, as the Argentines have been quick to point out on a number of occasions, both are also particularly well suited to producing the critical element for nuclear weapons.

Another signal considered by many to be pro-nuclear arose during a relatively early period of Argentina's nuclear power program when it decided to contract for natural uranium power reactors instead of enriched uranium reactors. In addition it is contended that the use of natural uranium reactors would allow the extraction of plutonium at a faster rate than could be extracted from enriched uranium reactors, and that the extraction process from natural uranium reactors could be accomplished undetected. A counter-argument from a purely economic standpoint is that natural uranium reactors are a more rational choice, given the country's abundance of uranium, and its lack of uranium

enrichment facilities. Although plutonium can be used to build weapons, it is equally valuable as a nuclear reactor fuel by itself or blended with enriched uranium.

Another pro-nuclear signal has been Argentina's refusal to agree to peaceful declarations through agreements. Argentina has not yet signed the Treaty on the Non-proliferation of Nuclear Weapons (NPT); it has signed but not ratified the Treaty for the Prohibition of Nuclear Weapons in Latin American, commonly referred to as the Treaty of Tlatelolco. The NPT, which has nearly 100 signatory countries, came into effect in 1975. It principally obliges each non-nuclear weapons state not to produce, acquire, or seek assistance in producing nuclear weapons. In addition it obliges non-nuclear weapons states to accept safeguards by the International Atomic Energy Agency in order to verify the states' obligations under the Treaty. Argentina has continued to express its unwillingness to agree to the provisions of the NPT for several reasons. Chief among these is the issue of security. Early in the discussions on the NPT, the Argentine ambassador to the United Nations summarized his country's point of view on the security aspect when he stated: "the first value which cannot be overlooked is the protection of the security of each member of the international community. In the present state of the international panorama, with nuclear and non-nuclear countries, nonproliferation freezes the existing situation. Consequently, it is necessary that the states which do not have nuclear weapons are given effective guarantees by those who, because of their greater nuclear power, have a

primordial responsibility in the nuclear sphere."[150] Argentina regards the NPT as discriminatory against the nuclear 'have nots' and insists upon the right to conduct so-called 'peaceful nuclear explosions.' A second important reason for Argentina's opposition to the NPT has to do with technical nuclear assistance. Article IV of the NPT calls for the exchange of equipment and information among signatory states to further the development of nuclear energy for peaceful purposes. And Article V enumerates the assistance that nuclear weapons states are to provide to non-nuclear states seeking the peaceful applications of nuclear explosions. A frequent charge made by Argentina, as well as other non-nuclear states, is that the nuclear states--chiefly the US and USSR--have not lived up to the obligations of these NPT Articles by failing to provide technical nuclear assistance in civil nuclear programs.[151] Because of reluctance on the part of the nuclear states, the non-weapons states feel less compelled to accept the NPT safeguard obligations. Under the NPT safeguard agreements, countries commit their indigenous and imported nuclear facilities to international control. Argentina has consistently opposed full-scope safeguards. In presenting the Argentine position, Castro Madero explained that:

> "the country...is not prepared to sign a blank check, which is what signing total safeguard agreements would amount to. Argentina believes that the countries which place their trust in and signed the NPT, which wrote a blank check, in exchange for the promise that they would get all the technology needed for their nuclear development

for peaceful purposes, have been completely defrauded."[152] While not currently obligated to the provisions of the NPT, Argentina has stated that it will continue to abide by the spirit of the NPT by not pursuing a nuclear weapons program. Yet most observers agree that Argentina's strategy with regard to the NPT will continue to be one of retaining its nuclear weapons option. From the Argentine perspective, the War of the Falklands reinforced the wisdom of retaining this option in view of the British use of a nuclear-powered submarine in that conflict.

Many observers believe Argentina's failure to ratify the Treaty of Tlatelolco is yet another major signal of its intentions to pursue nuclear weapons. The major provisions of the Tlatelolco Treaty are to prohibit and prevent in their respective territories any procurement of nuclear weapons; any form of possession of any nuclear weapons, directly or indirectly; or any participation in weapons acquisition or possession. As part of the treaty, a supervisory body, the Agency for the Prohibition of Nuclear Weapons in Latin America, (OPANAL), was established to conduct IAEA safeguard inspections. As of late 1984, 26 nations, principally those in Latin America, have signed the Tlatelolco Treaty. Argentina, objects to it on nearly the same grounds as they do the NPT. While the Argentine government in recent years has signalled its intent to ratify Tlatelolco, so far there has been much rhetoric but little action. In January 1985, Alberto Constantini, the current CNEA chairman, restated the nation's longstanding attitude toward nonproliferation by saying that Argentina had not signed the nuclear nonproliferation treaties

"because it wished to maintain its sovereign rights," and he went on to remark that these treaties are considered discriminatory.[153]

Economic Motivations.

Economics has been a prevalent consideration in Argentina's nuclear power program. Even though the motivation for its program during the emerging years of the 1950s was probably predominantly political, as resources were increasingly channelled into the nuclear power program, the fundamental justification shifted toward economics. Some observers view a linkage between economic and political considerations in the molding of Argentine nuclear power policy. One explanation for these motivations is historical. Up until about 1945, Argentina was largely dependent upon England for its coal supplies. As a result of cutbacks in coal exports in World War I and II, Argentina become painfully aware of it energy dependence.[154] But the roots of dependence, probably go much deeper than just energy. Some economists view the developing countries as being caught in a dependency syndrome, also referred to as the core/periphery relationship. This syndrome or relationship argues that the lesser developed countries are exploited by the advanced countries for their raw materials, and "...then keep the system perpetuated by exporting manufactured products back to the [developing countries] rather than allowing [them] to develop a strong domestic manufacturing system or much of an export exchange with the [advanced nations]..."[155] With the realization of this plight, the theme of self-sufficiency began to emerge in

some developing countries, and was especially strong in Argentina during the Peronist regimes. From the Argentine perspective, given its earlier history of economic dependence, it becomes more apparent why their nuclear policy has been strongly independent, relying to the greatest extent possible on their indigenous assets. Argentina only needed to observe the plight of the Pakistani and Indian nuclear programs after Western assistance was termineted, to remind them of the wisdom of pursuing an independent nuclear policy.

Economic development strategy has also acted to drive Argentine nuclear policy. This strategy included several facets. Because the nuclear program was a new scientific and technical endeavor, it attracted a growing number of talented people eager to pursue promising careers. In addition, the number of trained personnel increased as a result of educational opportunities in the nuclear field. Hence these educational programs served as a vehicle for teaching skills such as engineering and construction that would be valuable in other sectors of the economy.[156] Beginning early in the Argentine nuclear program, strong emphasis was continually placed on importing technologies. And imported technologies have been viewed by the Argentines as a direct means of raising the overall capabilities of the nation's economy.

Another economic motivation that helped to shape Argentine nuclear policy was the stimulus nuclear-powered electricity was expected to provide to economic growth.[422] This argument, however, appears to be somewhat unconvincing in view of Argentina's tremendous hydro-electric power capacity as well as

its untapped resources.

In view of the financial difficulties that are currently confronting Argentina and will likely remain, the traditional economic motivations that have helped to shape the country's nuclear policy in the 1960s and the mid-1970s will probably be decreasingly valid. An increasingly important economic motivation for Argentina's nuclear power policy, which began in the late 1970s and will likely extend through the 1980s is the export of its nuclear technology, materials, and equipment. Nuclear exports may help to ease the debt problems. From the perspective of the nonproliferation regime, it is feared that Argentina, with [its] nearly complete nuclear fuel cycle...will spread the nuclear technology to even more states that are not parties to the pacts of the nonproliferation regime or states that may seek to develop weapons."[158] In reaction to external pressures for Argentina to abandon its sensitive technology of plutonium reprocessing, Castro Madero responded that "...Argentina seeks to become an exporter of nuclear technology, and does not wish to enter an increasingly competitive market deprived of a very important part of the fuel cycle."[159]

Nuclear Options

Is Argentina's currently pursuing a nuclear weapons option? A number of analysts agree that there are various indicators that, in terms of its nuclear capabilities and actions, point to weapons procurement. There is a prevailing view that the nuclear policies of near-nuclear countries such as Argentina can be

expressed in different levels of actualization of their nuclear potential, and that each level becomes an option.[160] The three options are the 'Canadian,' the 'Israeli,' and the 'Indian.'[161] The maximum level of actualization...corresponds to...the Indian option: the country that selects this policy aims at assembling and testing explosive devices--"peaceful" or otherwise--demonstrating in this way its nuclear capability."[162] "...the Israeli option represents an intermediate strategy; it consists of the creation of all the material prerequisites for the production of weapons, short of the final stages of assembly...without acknowledging that this decisive threshold has been passed."[163] The important feature of the so-called Israeli option is the uncertainty it produces. The lowest level of actualization is referred to as the Canadian option, which "...consists simply of a public renunciation of the development of nuclear weapons. The nuclear potential is not actualized..."[164]

Argentina's nuclear policy would appear to most closely fit the Israeli option because of the uncertainty of its intentions. This uncertainty thus preserves an "aura of ambiguity."[165] While a nuclear policy of ambiguity forces Argentina to walk a kind of tightrope, there are also several benefits that can be gained by this policy as well. As pointed out by one analyst, "...it avoids provoking a neighbor to take matching steps to lead to a local nuclear arms race."[166] Additional advantages of pursuing an ambiguous nuclear policy are that it "...deflects nonproliferation policy pressures mounted by the major powers,

[it] buys desired time to augment indigenous technical or military capabilities, and [it] permits the state...to advocate arms control, nonproliferation or tension-reduction measures in international fora without facing charges of blatant hypocrisy."[167]

Impact on Regional Security Interests

Some observers believe that Argentina's ambiguous nuclear policy serves as a limited regional deterrent.[168] Its deterrence benefits from outside the region are probably questionable, however. Certainly England had a different perception of this so-called deterrence as it waged its operations against the Argentinians in the Falklands Islands. The weight of evidence indicates, however, that Argentina will continue to retain a weapons option, and "it does not appear that the Argentinians, while preserving the [nuclear] option, are actively pursuing a nuclear weapons capability."[169] The new Argentine government under Raul Alfonsin has signalled its intention to reorder the nuclear power program and to reexamine its position on nonproliferation. Such pronouncements have been echoed by previous Argentine leaders, yet no real changes occurred in the country's stance on nonproliferation.

Assuming that Argentina maintains its present nuclear policy of pursuing the peaceful applications of nuclear power and technology but preserves the full range of nuclear options, it would appear that within the regional context a status quo would prevail. So long as the Brazilian leaders believe that Argentina is not actively pursuing the procurement of nuclear weapons,

Brazil would probably be forced to make a difficult decision in order to respond to the Argentines. Yet Argentina's policy may already be destabilizing from Brazil's perspective. The Brazilians may feel sufficiently intimidated by the uncertainty of Argentina's policy, and have already begun weapons procurement in order to avoid lagging behind.

From the perspective of US security interests, Argentina's current nuclear policy is viewed as potentially destabilizing, beyond the Brazilian issue. Argentina has become an exporter of nuclear equipment and technology to its neighbors. US concern focuses on the extent of Argentina's export plans, which, if they include the export of sensitive technology, would have proliferation implications. To some extent, Argentina has acknowledged these concerns and has indicated that its nuclear exports to countries obligated by the NPT and Tlatelolco Treaty should be subject to the nuclear safeguards and inspection obligations under those treaties. But how agreeable will the Argentines be farther down the road if countries such as Paraguay or Peru seek plutonium reprocessing and uranium enrichment technologies and facilities from Argentina, especially when potentially lucrative contracts are involved?

What would be the likely impact of a dramatic, though probably unlikely, shift in Argentina's nuclear policy toward a nuclear weapons option? Such a decision might occur as a result of a military takeover of the government eager to reinstate Argentina to its 'rightful place as a Latin American power.' In so doing

they may decide to openly declare their intention to pursue nuclear weapons procurement and may even suggest weapons testing. Most observers believe that such a scenario would more then likely trigger a Brazilian response in kind. The question then arises as to whether or not the possession of rudimentary nuclear weapons by both sides would enhance or diminish security in Latin America. On the one hand, the two nations might realize that their security had increased as a result of possessing them. Each side might come to realize that it could inflict unacceptable damage on the other, which presumably would be sufficient reason not to, and would in effect create a mutual deterrence. On the other hand, it is probably more likely that nuclear weapons in the hands of both countries would reduce their security. If one side was to sense a qualitative or quantitative disadvantage, it would likely work to close the gap--thus creating the potential for a regional nuclear arms race.

What would be the impact on US security interests given the above scenario? Some observers believe that the impact would be minimal. It would not appear that US strategic stability would be threatened. Further, it is unlikely that the US and the Soviet Union would be drawn into an Argentine-Brazilian conflict because the superpowers' conflicting interests would probably be solvable through non-nuclear means.[170] Almost certainly US relations with both countries would worsen as a result. It is also likely, based on its steadfastly strong nonproliferation position, that the US would probably be "...tempted to punish the new nuclear state[s] through the imposition of economic or

political sanctions."[171] Nevertheless the reality of the situation would probably offer the US little leverage in any attempt to influence the actions of either country. Rather than taking the attitude akin to an angry parent toward its disobedient child, the US approach should be to attempt to persuade the countries to seek a moderate and nonaggressive foreign policy. As pointed out by one observer, "...solutions must be found for the security dilemmas of states like Argentina...which point away from the false salvation of nuclear weaponry and toward acceptable and workable arrangements."[172]

CONCLUSIONS

The nuclear energy program in Argentina, now nearly 35 years old, has to be viewed as a success story for this Third World country. Argentina's success seems even more remarkable given the political and economic turbulence that it has experienced during these three and one-half decades. One underlying reason for this success has been the adherence to several fundamental objectives. One of these objectives has been the pursuit of self-sufficiency or independence, in terms of energy sources. A second persistent objective of the program, which is closely related to the first, has been its development of a talented and highly skilled scientific and technical infrastructure. A third enduring objective has been the accession of the necessary nuclear technology that would allow the eventual development of a nuclear program with a minimum of outside assistance.

Another underlying reason for the success of Argentina's nuclear program has been its nuclear energy commission, the CNEA. This organization was led by generally competent men who, through their effective management and long tenure, added continuity to the organization and relative constancy of the program's fundamental objectives.

The scientific infrastructure as well as the associated nuclear industry that Argentina has developed through its cooperative efforts have led to its position as an emerging regional exporter of nuclear power technology and equipment.

Despite the record of successes that the Argentine nuclear power industry has achieved over several decades, the difficult financial and economic problems that are now confronting it could seriously jeopardize the continued growth of the nuclear power industry. Problems in the nuclear industry could have a ripple effect on several other segments of the economy. The nuclear program has already experienced deep budget cuts and this trend is likely to continue.

Argentina's nuclear policy has been, and probably will continue to be, aimed at independence. The nation declares its policy to be primarily for peaceful purposes, yet it has, to date, refused to sign and ratify two important international and regional nonproliferation agreements. The civilian government of Raul Alfonsin has vowed to re-examine the country's nuclear policy priorities and to reconsider these agreements. A number of

observers believe that even though Argentina's declared nuclear policy is only for peaceful purposes, its noncommitment to binding agreements is evidence that Argentina wishes to keep open a nuclear weapons option. Their loss in the Falklands War may have reinforced this position.

It appears unlikely that Argentina will dramatically change its declared nuclear policy, and is apparently satisfied to create a certain air of ambiguity as to its intentions. If Argentina were to acknowledge openly its intent to procure nuclear weapons, its rival, Brazil, could be expected to respond in kind. The outcome of a rudimentary nuclear capability in the hands of both countries could be destabilizing by creating a regional nuclear arms race. On the other hand, the possession of such weapons by both could serve as a mutual deterrence. While the political impact of the possession of nuclear weapons by Argentina and Brazil would probably be significant, it is unlikely that the situation would directly affect US security interests.

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