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BACKGROUND PAPER

LATIN AMERICA: NUCLEAR FACTS AND FIGURES

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Executive Summary

The countries of Latin America have a long history of involvement in nuclear issues, and the region was the first to create a nuclear weapons free zone through the Treaty of Tlalelolco in 1967. Some are also very active in international forums dealing with nuclear issues. Brazil is credited with being one of the few countries to have voluntarily abandoned a nuclear weapons program—though Argentina had a similar program which did not advance as far as its neighbour.

There are extensive uranium deposits in Latin America, with the larger ones, however, concentrated in Brazil and Argentina. Brazil also has one of the largest thorium deposits in the world, though no country has yet established a thorium-based fuel cycle, and currently only India has an R&D program in this area. Venezuela also has large thorium deposits.

Only three Latin American countries—Argentina, Brazil, and Mexico—have nuclear power reactors (two each). Moreover, those reactors only supply a very small proportion—3% to 7%—of national energy needs. Though these countries have ambitious expansion plans, the proportion of energy supplied by the nuclear sector will still be small, and there will be continued heavy reliance on more traditional energy sources such as hydroelectricity and hydrocarbons. The current international financial crisis may also limit these expansion plans for some time, and limit the plans of neighbouring countries to develop their own nuclear power sectors.

Of these, the country with most resources to succeed is Chile, though its location along a major tectonic fault line will bring safety problems of its own. Uruguay and Venezuela are also thinking of developing a nuclear sector, but these are still very much only on the drawing board. Venezuela, because of its interest in developing ties with Iran, is being watched closely in this regard. Finances will be a limiting factor in the case of Uruguay.

Introduction

According to many observers, including the present writer who lived in a variety of Latin American countries for a number of years in the 1980s and '90s, the threat of

nuclear annihilation has never generated waves of existential angst amongst the general populations of Latin America and the Caribbean to anything like the same extent as it has in North America, Europe and elsewhere. That is possibly because of the preoccupation of those populations with more immediate and pressing challenges of economic, social—and at times, political—rights and development. But that is also not to say that those countries themselves have not been active on international nuclear issues at various levels over the years.

Three countries from the Latin American and Caribbean region are known to have at one time or another harboured desires to acquire nuclear weapons: Argentina and Brazil, particularly during the years of military dictatorship there, through indigenous programs of their own; while Cuba intended to allow the deployment of Soviet missiles with nuclear warheads on its territory. Construction of a power reactor was also begun during the Soviet years, but was suspended indefinitely. Cuba still has a Soviet-era research reactor. Argentina and Brazil, on the other hand, in the 1970s and early 1980s, both pursued secret military programs aimed at mastering the complete nuclear fuel cycle, though Brazil was the more successful of the two in this regard. Both also pursued active missile development programs, as well as successful civil nuclear energy programs. With the return of democratic governments in both countries in the mid-1980s, their military nuclear programs were scrapped, with Brazil in particular reaping international kudos for being only one of a handful of countries to have voluntarily renounced an advanced nuclear weapons program.

Tlatelolco Treaty

Perhaps as much to do with the nuclear aspirations of these countries in their midst, as it had to do with fallout from Cuban missile crisis, the other countries of the Latin American and Caribbean region were the first in the world to declare their region a nuclear-free zone.¹ This was done through the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean, otherwise known as the Treaty of Tlatelolco. It was signed in the Tlatelolco district of Mexico City in 1967, and entered into force in 1969. It has now been signed and ratified by all 33 nations of Latin America and the Caribbean. Argentina only became a party to it in 1994. Cuba was the last country to ratify, on 23 October 2002. Brazil had in fact signed it in 1967, but did not let this stand in the way of its own nuclear weapons program (relying on the peaceful nuclear explosions provision?).² It followed Argentina in ratifying the Treaty in 1994.

Under the treaty, the parties agree to prohibit and prevent the “testing, use, manufacture, production or acquisition by any means whatsoever of any nuclear weapons” and the “receipt, storage, installation, deployment and any form of possession of any nuclear weapons.” However, a serious weakness in the treaty is that it allows parties to develop nuclear explosives for peaceful purposes. The treaty also provides for a comprehensive control and verification mechanism, overseen by the

¹ Antarctica had been declared a nuclear-weapon-free zone under the 1961 Antarctic Treaty.

² Brazil’s signature was not in fact deposited until 1968, and included a reservation concerning Article 18 of the Treaty, which Brazil interpreted as allowing nuclear explosions, as long as they were for peaceful purposes.

<http://disarmament.un.org/TreatyStatus.nsf/c47b316da30f1e2a8525688f006b9c25/c3acc808537bf50d8525688f006d2336?OpenDocument>

Agency for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (OPANAL³), based in Mexico City.

There are two additional protocols to the treaty: Protocol I binds those overseas countries with territories in the region (the United States, the United Kingdom, France, and the Netherlands) to the terms of the treaty. All four of those states have acceded to this Protocol. Protocol II requires the nuclear-weapons states (NWS) so designated in the Non-Proliferation Treaty states to refrain from undermining in any way the nuclear-free status of the region. This Protocol has been signed and ratified by all five NWS.

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Nuclear Energy

Apart from questions of national prestige and historical competitiveness with each other, part of Argentina and Brazil's original motivation in embarking down the nuclear road was to obtain the benefits of civil nuclear energy. Both have continued their nuclear energy programs, though in fits and starts, and were joined by Mexico in this. It should be noted that Mexico has no record of any interest in acquiring a nuclear weapons capacity, and it has, in fact, been active in the opposite direction.

Table 1

<u>Country</u>	<u>Reactor</u>	<u>Location</u>	<u>Model</u>	<u>Nett Output (MW)</u>	<u>First Power</u>
Argentina	Atucha 1	Buenos Aires	PHWR – Siemens	335	1974
	Embalse	Córdoba	PHWR – Candu 6	600	1983
Brazil	Angra 1	Near Rio de Janeiro	PWR	626	1982
	Angra 2	Near Rio de Janeiro	PWR	1275	2000
Mexico	Laguna Verde 1	Veracruz	BWR	654	1989
	Laguna Verde 2	Veracruz	BWR	654	1994

Legend:
 BWR: Boiling Water Reactor
 PHWR: Pressurised Heavy Water Reactor
 PWR: Pressurised Water Reactor

Each of these three countries has two nuclear power reactors each (see Table 1).⁴ Chile, Uruguay, and Venezuela are also examining the possibility of starting nuclear

³ Organismo para la Proscripción de las Armas Nucleares en la América Latina y el Caribe.

⁴ This section is based on Woods, Randy. "Latin America on Verge of New Nuclear Age", Energy Tribune, 16 April 2008. <http://www.energytribune.com/articles.cfm?aid=863>; and from Cevallos, Diego. "Latin America: Nuclear Energy Reborn", IPS-Inter Press Service and IFEJ-International Federation of Environmental Journalists, 3 October 2006. <http://www.tierramerica.net/english/2006/0930/iarticulo.shtml>

energy programs of their own, though financial—and to a lesser extent, environmental—factors may be factors in limiting these aspirations, particularly in the context of the current international financial crisis. Of the three, Chile is possibly perhaps the only one with the financial resources to sustain such a program.

There are some common factors in the motives driving all these countries' interest in nuclear energy generation, and they are shared elsewhere in the world. In part they rest on the increased costs and future dwindling supplies of hydrocarbons such as oil and natural gas. For some Latin American countries (such as Argentina, Brazil and Chile) which have in the past relied heavily on hydro-electricity, climate change has started to make output from this sector variable and uncertain. For others, environmental considerations and pressures are making coal-fired energy plants less attractive.

Argentina, Brazil and Mexico all have plans to significantly increase their current nuclear energy output, though in some cases they will be cutting costs by using plans that were originally drawn up, or restarting projects that were mothballed, twenty or more years ago.

Even with significant expansion, however, the nuclear sector would only be supplying a small fraction of those countries' overall energy needs. According to 2007 figures, Argentina's current nuclear energy output only amounts to 6.2% of its total; in Brazil it is 2.8%; and in Mexico 4.6%.⁵ The expansion plans currently under consideration would roughly double these figures, but they would still be well below the worldwide figure of 16%⁶ of electricity being generated by nuclear reactors.

In addition to the above power reactors, there are 24 research reactors in the region, of which five are not currently in operation. Peru and Chile both have two (though one of the latter's is not operational); and Colombia, Cuba, Jamaica, Uruguay and Venezuela have one each (the Uruguayan one also being non-operational). The remaining 15 are in Argentina, Brazil and Mexico.⁷

This perhaps underlines the fact that in Latin America the chief benefit of nuclear science will be not so much in the form of electricity generation, but in medical applications, water resource development and agricultural research. The latter will be particularly important in Latin America, as in the rest of the world, in light of growing international food shortages. It might be noted in this regard that the IAEA has carried out work in this regard, particularly relating to food production and preservation.

⁵ Álvarez Valdés, Rodrigo. "Armas Nucleares: La Incertidumbre de la No-Proliferación y el Desarme", FLACSO, Santiago, Chile. 2008.

⁶ Letts, M. and Cunningham, F. "The Role of the civil nuclear industry in preventing proliferation and in managing the second nuclear age", ICCND Research paper 2009.

<http://www.icnd.org/latest/research/index.html>

⁷ Álvarez V. *op. cit.*

Nuclear Fuel Supply

Uranium

Argentina and Brazil are also lucky in the sense that they have extensive uranium deposits, with more having been recently discovered.⁸ Argentina, though, currently finds it difficult to attract foreign mining companies to exploit these reserves, and imports most of the uranium used in its reactors from Canada. Both countries have also developed their own capacity to enrich uranium. A number of other countries in the region also have uranium mining projects. These include Mexico, as well as, Bolivia, Chile, Colombia, Ecuador, Guatemala, Guyana, Paraguay, Peru, and Uruguay. Although the uranium reserves in some of these countries are relatively low, there is nonetheless the potential for being a regional uranium supply source if the need arises.

Latin America is also a potentially rich source of other minerals used in connection with nuclear reactors: beryllium, hafnium, and zirconium.

Thorium

Another potential nuclear fuel, thorium, is plentiful in one or two Latin American countries (Brazil, and to a much lesser extent Venezuela). However, currently there is limited interest in developing a thorium-based fuel cycle, apart from in India. Indeed, there is such little demand for thorium currently that there is little exploration for it. There are significant conflicts in the estimates of world thorium reserves. The 2005 IAEA-NEA “Red Book” suggests a probable thorium reserve of 4.5 million tons worldwide, though acknowledges that the lack of figures for many parts of the world makes this little more than an educated guess. It is nevertheless known that thorium is 3 to 4 times as common on the surface of the earth as uranium.

According to some figures, Australia has the largest reserves, with India coming second, each with about 25% the world’s total.⁹ However, both the IAEA and OECD put Brazil at the top of the list by a significant amount, over Turkey then India.¹⁰

⁸ See New Uranium Mining Projects—South/Central America <http://www.wise-uranium.org/upsam.html>

⁹ US Geological Survey, Mineral Commodity Summaries (1997-2006).

¹⁰ The current known thorium reserve of India could supply all of the electrical energy at the rate India now users for 300 years. Current Indian estimates place the Indian thorium reserves at between 3.60 and 5.18 million tons. <http://nucleargreen.blogspot.com/2008/03/today-nuclear-power-offers-large.html>

COUNTRY NOTES

Argentina

Argentina takes an active interest in international nuclear issues, and is engaged actively in the wider international arms control debate. At the time of writing, it may field a candidate for the position of Director-General of the IAEA.¹¹

Argentina and neighbouring Brazil have historically been major competitors across the board, and the same has been true in the past in the nuclear field as well. During the military dictatorships which existing in both countries during roughly the same periods in the 1970s and '80s, Argentina and Brazil also embarked on both civilian and more clandestine military nuclear programs—though the latter program apparently did not progress as far as its Brazilian equivalent. It was abandoned when Argentina returned to civilian democratic rule in 1983. In 1991, Presidents Carlos Menem of Argentina and Fernando Collor of Brazil signed an accord with the International Atomic Energy Agency (IAEA) in Vienna that provided for IAEA inspection of their respective nuclear programs. In the same year, the bi-national Brazil-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC), was set-up to carry out verification activities.

Argentina currently relies heavily on hydroelectric dams and fossil fuels (principally coal) for its energy generation. As noted earlier, Argentina currently has two nuclear energy reactors, Atucha I, 100 km from Buenos Aires, and Embalse, in the north-central province of Córdoba. Built in 1974, Atucha I was the first nuclear-electrical plant in Latin America. Embalse began to produce energy in 1984. These two reactors currently produce 6.8% of Argentina's energy needs. But the government is planning to double this over the next decade. Its original plants had an estimated lifespan of 30–40 years. However, this has now been extended by the Argentine authorities to around 60 years.¹² Both plants have had accidents over the years, and displayed faults needing correction.

In 2006, Argentina restarted construction of the 745 MW Atucha II plant, which had begun in 1981 but was mothballed in the mid-1990s despite the fact that it was nearly 80 percent complete. The German company Siemens, which built the existing Atucha-I plant, is providing technical assistance in the completion of Atucha II. The expected completion cost is in the order of US\$600 million. Argentina is also planning to upgrade its Embalse plant, though this is unlikely to come online for some years yet. Argentina also intends to start feasibility studies for a new plant, although the government's fiscal problems may stall the project.

Apart from Atucha II, ambitious plans have also been announced for the construction of five more nuclear plants by 2023.¹³ However, it is currently estimated that by 2010,

¹¹ The candidate is likely to be Rogelio Pflirter, the current head of the Organization for the Prohibition of Chemical Weapons in The Hague, and a seasoned former nuclear treaty negotiator.

¹² Cevallos, Diego. "Latin America: Nuclear Energy Reborn", *IPS-Inter Press Service and IFEJ-International Federation of Environmental Journalists* report, 3 October 2006.

¹³ Squassoni, Sharon. "Nuclear: Latin American Revival?", *Americas Quarterly*, Winter 2009.
<http://www.carnegieendowment.org/publications/index.cfm?fa=view&id=22755&prog=zgp&proj=znpp>

there will already be a significant shortfall in electricity production over projected needs. Given that even with five extra nuclear plants, their total contribution to the future electricity grid of the country would only be around 10% of the total, it is more than likely that Argentina will be reliant on its more traditional power plants for many years to come. In this regard, it is worth noting that the country's hydro potential is currently estimated to be only 20% utilised. That would suggest itself as the most feasible—and clean—option for Argentina to pursue.¹⁴

The country is also once again studying the feasibility of producing enriched uranium. Efforts to this end had begun in the 1980s, but were halted in 1992. Argentina has built a pilot module for a diffusion enrichment process. It has now entered into an enrichment partnership with Brazil, though details of how this would work have not been released. It is nevertheless understood that initial enrichment might take place in Argentina and the slightly enriched uranium (1%?) would then be sent to Brazil for enrichment to normal commercial levels (around 4%).

Both the Atucha 1 and Embalse power plants are pressurised heavy water reactors (PHWR) using heavy water as coolant and moderator. Embalse is operated on natural uranium, Atucha 1 is operated on uranium enriched to 0.85% U-235, which is slightly above natural uranium. Although Argentina has its own uranium reserves, with more recently discovered, it no longer carries out uranium mining for economic reasons. It obtains its natural uranium instead from Canada, and, according to the World Nuclear Association, its enrichment services from the United States (though this may change in the light of the agreement Argentina reached with Brazil as mentioned above).

Argentina also has significant heavy water infrastructure facilities, including research and development, heavy water production, fuel manufacture, and supply of certain components. It also has an active export business. The Argentine nuclear engineering firm INVAP has sold research reactors to Australia, Libya and Egypt, and CNEA (the Argentine National Atomic Energy Commission) supplies fuel for those reactors. Another possible market for INVAP reactors is Jordan, with which Argentina signed a nuclear cooperation agreement in 2008.¹⁵

Argentina's nuclear activities have been carried out under full-scope safeguards since 1991 under IAEA auspices and in conjunction with ABACC. Argentina has not, however, signed an IAEA Additional Protocol for strengthening safeguards, saying that it prefers to wait for Brazil to do so. Argentina and Brazil, with Venezuela, are thus three of only six parties to the NPT having significant nuclear activities which have refused to sign an Additional Protocol. Argentina is a member of the Nuclear Suppliers Group.

Brazil

Brazil is a major player on the international stage, including on nuclear issues. Its Ambassador Sergio Duarte is the UN's High Representative for Disarmament and was Chair of the 2005 NPT Review Conference. Brazil is an active participant in

¹⁴ *Ibid.*

¹⁵ NTI Research Library. "Argentina Profile". Updated February 2009. http://www.nti.org/e_research/profiles/argentina/index.html

associated debates. It also enjoys the kudos it receives for being one of the few countries in the world to voluntarily surrender its nuclear weapons program.

Nevertheless, there is some doubt as to the level of progress that program achieved before it was abandoned. According to some observers, the Brazilian military junta that ruled from 1964–1985, never got all that far in its plans to build nuclear weapons.¹⁶ According to those observers, the program, which began in 1979 and was mainly run by Brazil's navy, had mastered the uranium enrichment process, but in doing so had not been able to use a reactor developed and built entirely with Brazilian technology. Nevertheless, Brazil's two Presidents following the return to democracy in 1985, both revealed details of the clandestine nuclear weapons program, including details of two nuclear weapons which had been designed, though not actually built. President Fernando Collor de Mello symbolically closed down the nuclear weapon program in 1990.

Brazil is today part of the India–Brazil–South Africa Dialogue Forum (IBSA), a fairly recent (2003) alliance of countries who have or have had nuclear ambitions of their own in the past and present. IBSA has as one of its principal aims to galvanise South–South cooperation and greater understanding between the three important continents of the developing world in which each country is located, namely Africa, Asia and South America. The forum provides the three countries with a platform to engage in discussions for cooperation in the field of agriculture, trade, culture, and defence among others.¹⁷ It has not, however, yet played any significant role in the international nuclear debate.

On the nuclear energy side, Brazil has two functioning nuclear plants, Angra I and II 130 km west of Rio de Janeiro, which together produce only 2.8% of Brazil's overall energy needs. Angra I was inaugurated in 1985, and Angra II in 2000. As with Argentina, Brazil's existing nuclear plants also had an estimated useful life of 30–40 years, but the government plans to prolong their operation to a maximum of 60 years.¹⁸

Like Argentina and Mexico, Brazil's electricity needs are expected to skyrocket in coming years. In the short term, Brazil is therefore now seeking to complete construction of a third reactor—the 1,350 MW Angra III plant—which was in effect mothballed by the newly restored democratic government of Brazil in the mid-1980s due to funding shortages. At the time, the government had already invested over US\$800 million in the project, and it is now expected to cost more than \$4 billion to complete. Work on Angra III restarted in June 2007. France's Areva NP will provide the technology. The project is not expected to come online for several years. In addition, Brazil plans to build four plants by 2030, each with 1 gigawatt of capacity. It is currently considering where to build them, though they may all be in the same area as the existing plants.

The question of location is a sensitive one since considerable controversy has already been generated in relation to Angra III. There was apparently a poorly conducted

¹⁶ <http://www.brazil.com/articles/184-october-2007/9990.html> See also Álvarez V. *supra*.

¹⁷ Wikipedia. http://en.wikipedia.org/wiki/IBSA_Dialogue_Forum

¹⁸ Cevallos, *op. cit.*

geological survey which did not pay adequate attention to a known history of landslides in the area caused by unstable soil. Unlike many other countries in the region, there is an active environmental lobby in Brazil which opposes widening Brazil's nuclear energy plans.

In light of Brazil's estimated energy needs over the next fifty years, it has been estimated that it would require at least 58 new nuclear plants if all of the increased electricity were to be nuclear generated. Quite apart from the enormous financial strain this would impose on any country, environmental concerns would also be extremely influential in Brazil. At present, 92% of Brazil's energy generation is from hydroelectric sources, including the massive tripartite Iguacu dam on the border Brazil shares with Argentina and Paraguay.¹⁹ Further expansion of this sector is possible. Moreover, serious suggestions have been made, including by Brazil's nuclear association, that diversification should occur into not only more nuclear plants, but natural gas and biomass fuelled ones as well.²⁰ However, in response, the present government of President Luis Ignacio "Lula" da Silva has already ruled out solar or wind plants as replacement energy sources, arguing that they are more expensive than a nuclear plant.

Brazil has the sixth largest reserves of uranium in the world, and is one of only nine countries that can enrich uranium. It opened its first commercial centrifuge-based uranium enrichment plant in May 2006, and is currently seeking to expand production. The fact that this plant uses gas centrifuge technology, which is also used by Iran, and controversy in late 2005 over UN action over Iran, caused the Brazilian government to postpone the official opening of the plant, which had originally been set for January 2006. It is worth noting that Brazil's Constitution bans not only nuclear weapons but also the export of enriched uranium. Brazil is also, of course, party to a variety of non-proliferation agreements, including the NPT which it finally ratified in 1998. Brazilian officials have nevertheless been reported as saying that the country's enriched uranium could also supply Argentina's nuclear energy plants.

It is worth noting that Brazil has undertaken to enrich to only 3.5% U-235, which is the concentration used by its two existing reactors. This is well below weapons grade, which is 90%.

Some observers have expressed concern over relatively recent reports in which Brazilian officials have also been reported as saying that enrichment should be available to the military. While the concern expressed might be understandable, in one sense that horse has already bolted. Brazil's enrichment program was originally developed by the Brazilian Navy, and it continues to be owned by it. The commercial enrichment plant mentioned above is operated by a civilian company, but the Navy continues to operate its original pilot plant.

Some controversy has, however, arisen over the stance of the Brazilian President, who on 10 July 2007, announced his intention to fulfil one of the Brazilian Navy's ultimate

¹⁹ All of Paraguay's energy needs are in fact met by its share in the dam, with a considerable surplus which it sells to its neighbours.

²⁰ Squassoni, *op. cit.*

dreams: to launch a nuclear-powered submarine by 2015.²¹ This idea was originally part of a 1975 agreement between Brasilia and the then Western German government. A nuclear powered submarine is not, of course, the same as a nuclear weapon by a wide margin. Lula's plan, moreover, may be put on the back burner by the current international financial crisis. However, should the plan ever come to fruition, Brazil's status within at least the Treaty of Tlatelolco is likely to be questioned,²² and the possible reactions of its neighbours taken into account.²³ In addition, Brazil's credentials in the corridors of the NPT may also be called into question.²⁴

As noted in the section on Argentina, Brazil recently signed an enrichment cooperation agreement with that country. Argentina is restarting its own diffusion enrichment efforts, and it appears likely that, under the agreement with Brazil, it will enrich uranium slightly to around 1%, and Brazil will then enrich it further to commercial levels (4%).

As also noted above, Brazil is one of only six countries with significant nuclear activities which refuses to sign an Additional Protocol with the IAEA. Brazil's reasons for this are unclear, though in the past Brazilian officials have complained that the AP extra inspection regime is too rigid, that it unnecessarily applies to universities and research institutions, and that it might open them to technological piracy.²⁵ More recently, Brazil has indicated that it is not prepared to assume more burdens until the NWS do more on disarmament. Otherwise, Brazil's nuclear activities come under full scope IAEA safeguards in conjunction with the Argentina-Brazil Accounting and Control Commission (ABACC).

Like Argentina, Brazil is a member of the Nuclear Suppliers Group. It is also a member of the Missile Technology Control Regime.

Mexico

Mexico currently has two operating nuclear power reactors—Laguna Verde I and II—in Veracruz State, 290 kilometres northeast of Mexico City. In September 2006 the Mexican government announced a plan to build a further two reactors in the same area, which are unlikely to come online until 2015. The government has also opened bidding for expansion of the capacity of the two existing plants from the current 1268 to 1620 megawatts. 4.6% of Mexico's electricity is currently supplied by those two plants. There has also been talk of Mexico building a further eight nuclear reactors,²⁶ though details of such plans have not been released.

²¹ <http://www.brazzil.com/articles/184-october-2007/9990.html>

²² There would not, however, appear to be any legal grounds within the terms of the Treaty to object to Brazil's actions since the country could even develop nuclear explosives—as opposed to weapons—pursuant to Art. 18 and still comply with its Tlatelolco undertakings.

²³ While a Brazilian nuclear submarine is unlikely to provoke Argentina into a race to build its own, it is nonetheless likely to stir Argentine memories of its cruiser, the *ARA General Belgrano*, which was sunk by a British nuclear submarine during the Falklands/Malvinas war.

²⁴ However, once again, Brazil will probably be in the clear since IAEA safeguards agreements provide for removal of safeguards for naval fuel, which is not seen as being contrary to the NPT.

²⁵ Massarani, Luisa. "Brazil Denies Refusing to Allow Nuclear Inspections," SciDev.Net, 4 January 2004, <http://www.scidev.net/news/index.cfm?fuseaction=printarticle&itemid=1173&language=1>

²⁶ Squassoni, *op. cit.*

The existing Laguna Verde plants have been subject to some administrative and security mistakes, as well as some fissures in the plants themselves, according to reports from the World Association of Nuclear Operators. The government has responded by saying these were all minor events which have already been corrected. Nuclear waste from the plants is stored on site, and a further dispute has erupted over waste management, with Greenpeace Mexico claiming that the waste deposit sites are full, and the government claiming there is capacity to store waste in them for several decades to come. Mexican authorities have also referred somewhat vaguely to future technologies which could transform the radioactive waste into a harmless form.²⁷

As for the expansion plans, some have questioned whether, even if fully realised, they could supply any significantly larger proportion of Mexico's energy needs. National electricity demand is projected to grow 6% annually, which puts the country roughly in the same category as India and China. Even with eight new reactors, their total output would still only amount to around 12% of Mexico's projected electricity generation. Given that the two existing Laguna Verde plants took 15 and 19 years respectively to come fully on-line, some considerable doubt must be said to exist over exactly when any new nuclear plants are likely to start contributing to the national electricity grid in any case. It is thus likely that Mexico's currently heavy reliance on oil and natural gas-fired power plants will continue into the foreseeable future.²⁸

SIEPAC

In the context of Mexico's energy needs, it is worth mentioning that Mexico is part of a project which is currently underway. Called SIEPAC (*Sistema de Interconexión Eléctrica para América Central* or Central American Electrical Interconnection System), it involves construction of nearly 1800 km of power lines to interconnect the power grids of six Central American nations (Panama, Costa Rica, Honduras, Nicaragua, El Salvador, and Guatemala) with that of Mexico. It is not clear if Belize, which already buys much of its power from Mexico, will also be included. Although originally intended to be completed by 2006, current estimates are for it to be ready in 2009.

The project has generated considerable controversy over the years since it was first contemplated in 1987, about its benefits and likely environmental impact. Supporters see the project as a means of alleviating periodic power shortages in the region, reducing power costs to consumers and operating costs generally, optimising shared use of hydroelectric power, creating a competitive energy market in the region, and also attracting foreign investment in power generation and transmission systems, and possibly also in other energy-intensive industries as well.

It should be noted that SIEPAC has no connection to nuclear energy, except to the extent that a small part of Mexico's national energy grid is supplied by that sector.

²⁷ Cevallos, *op. cit.*

²⁸ Squassoni, *op.cit.*

Chile

Chile is an active player in the international nuclear debate, as it is on questions of arms control and disarmament more generally. At the time of writing, it is possible that it may also field a candidate for the position of Director-General of the IAEA.²⁹

Of the other countries interested in acquiring the capacity to generate nuclear energy, Chile is the one with greatest potential, financial and technical, to achieve this. Chile has for a number of years suffered a severe power crisis due to dry weather which has limited its hydroelectric capacity, as well as restrictions in gas supplies from Argentina and fears about the recently nationalised gas industry in neighbouring Bolivia from which it also obtains supplies. As the world's largest producer of copper, which until recently has recorded high returns on international markets, Chile has the financial means to deal with its power shortages.

High-level studies on nuclear options have already begun, with endorsement from the country's President, Michelle Bachelet. Planners have apparently had some initial concerns that Chile lacks the human resources needed to run a nuclear program, though have not ruled it out as an option. Nuclear power companies from Canada, the U.S., and France are already lining up to extend assistance. Depending on developments on the international financial front, it is likely that Chile will have its own nuclear energy program in the next decade or so. Such a program is unlikely to be large, however, and would probably not exceed 1 GW in output, given the relatively small size of Chile's power grid. At the same time, however, any effort to set up such a program is likely to excite the opposition of Chile's active environmental lobby. Chile is located along a significant tectonic fault line, and is seismically very active. There are a number of active volcanoes in the Andes which form Chile's eastern border, and earthquakes are common. However, the Presidential Commission which examined the issue concluded that the anti-seismic technology and engineering available in Chile could guarantee acceptable safety levels for the installation of nuclear power reactors.³⁰

Chile has two nuclear research reactors, both located in Santiago. Chile has also signed an Additional Protocol with the IAEA (as has neighbouring Peru, which also has two research reactors.)

Cuba

As mentioned earlier, Cuba has a Soviet-era nuclear research reactor. It had also begun construction of two Soviet power reactors near Cienfuegos in the east of the island in the mid-1980s, which were meant to alleviate Cuba's chronic power shortages. However, work on them was suspended indefinitely when Cuba was unable to meet the financial terms required by a newly capitalist post-Cold War Russia. Talks to revive the project have continued over the years, though no work has been undertaken to this end. Cuba nevertheless receives funds and technical assistance

²⁹ The candidate may be Milenko Skoknic, Chile's ambassador to the IAEA and previously chairman of the IAEA board.

³⁰ The full Zanelli Report is to be found at http://www.cchen.cl/mediateca/PDF/report_zanelli.pdf

from the IAEA for maintaining the mothballed reactors, and in using its research reactor.

The United States has expressed concern at the possibility of the Cienfuegos reactors being completed. It has cited national security and environmental concerns about the possibility of a nuclear accident at the plants.

Uruguay

The other countries which have also shown some interest in acquiring a nuclear energy capacity, Uruguay and Venezuela, are in only the very early stages of considering such a program. Uruguay's only began doing so in February 2008 when nuclear energy was seen as a possible response to a fall in hydroelectric production due to changed climatic conditions. One initial hurdle which would need to be overcome in setting up such a program is an existing law prohibiting nuclear energy in the country.

Around 90% of Uruguay's power is generated from hydroelectric dams. However, given Uruguay's small population (3.5 million), and the huge costs involved, particularly in the current international financial crisis, a nuclear energy program would be an enormous drain on the country's resources. There was apparently a project to build an LNG regasification plant near the country's capital, Montevideo.³¹ Although such a plant would have provided a more cost effective solution to the country's energy needs into the future than nuclear energy, this plan was apparently dropped in 2005 because of the cost involved (\$200 million) and the time it would take to build (an estimated 26 months). By contrast, a nuclear plant would have cost around \$6 billion and taken at least five or six years to build—showing that the nuclear option is not really a serious one for this small country.³²

Venezuela

Venezuela has also begun considering construction of a nuclear power reactor in the light of severe power outages caused by the inability to meet increasing demands on the national power grid. But beyond that, it is difficult to ascertain any facts about putting such a plan into effect. It has been reported that since about 2005, Venezuela has sought to obtain nuclear technology from both Argentina and Brazil. Nothing has come of such approaches, and this could have been because of concern over possible proliferation in the region, as much as by concern over a likely U.S. reaction.

It is currently thought to be considering construction of a nuclear power plant by Russia of a type similar to the one installed by Russia in Iran at Bushehr. During a visit by Russian President Dmitry Medvedev to Caracas in 2008, a framework agreement was signed establishing "cooperation in thermonuclear fusion, the safety of nuclear facilities and radiation sources, as well as the design, development, construction, operation and decommissioning of research reactors and nuclear power

³¹ Woods, Randy. "Latin America on Verge of New Nuclear Age". The Energy Tribune, 16 April 2008. <http://www.energytribune.com/articles.cfm?aid=863>

³² Squassoni, *op. cit.*

plants.”³³ France is also believed to be interested in supplying Venezuela with nuclear technology, but few details are available.³⁴ In 2005, the Argentine media reported that Venezuelan officials from the parastatal oil company PDVSA had expressed interest in acquiring small Argentine reactors (CAREM) currently in the development stage. They would apparently be installed in Venezuela's Orinoco oil belt.³⁵ The reactors would be used to produce high-temperature vapour which could be injected into the ground to liquefy heavy oil.

More worrying for some have been Venezuela's efforts to build relations with Iran, and there has been speculation that this could include a Venezuelan uranium for Iranian nuclear technology deal. Venezuela itself helped fuel such speculation in the UN when it joined a small group of countries supporting Iran's resumption of its nuclear program without international supervision. However, it is not clear that Iran would have any need for Venezuelan uranium.

Venezuela indeed does have uranium, though the amount of its reserves is unclear. It also reportedly has a few operable uranium mines. However, even here things are somewhat murky as Venezuelan officials have been reported as denying that Venezuela has any uranium reserves at all but, in the same breath, saying they are “not excavating these deposits for enrichment purposes.”³⁶ Even the US State Department has indicated that while it is aware of the rumours about Venezuela supplying Iran, it says it has seen no evidence that in fact Venezuela's uranium deposits are being mined.³⁷ Nevertheless, the Russian-Venezuelan framework agreement includes provision for assistance in uranium development.

Venezuela of course has no capacity to enrich any uranium. It is in any case highly likely that the United States, and most probably also Colombia and others in the region and elsewhere, would strenuously oppose any nuclear deal between Venezuela and Iran, let alone one which would give Venezuela such a capacity.

As already mentioned in relation to Argentina and Brazil, Venezuela is one of only six countries with significant enough nuclear activities in the eyes of the IAEA,³⁸ to refuse to sign an Additional Protocol.

Colombia

Colombia might be mentioned in passing in the nuclear context, not because of its limited uranium reserves, or because it is considering joining the nuclear club (which it is not). However in early 2008, Colombia authorities seized the laptop of a commander of the Colombian Revolutionary Armed Forces (FARC) they had just

³³ “Russia, Venezuela Ink Nuclear Cooperation Deal”. RIA Novosti, 27 November 2008.

³⁴ “Venezuela, France Eye Nuclear Energy Cooperation”. Associated Press, 2 October 2008.

³⁵ Natasha Niebieskikwiat, “Chávez confirmó que busca un acuerdo nuclear con Argentina” (“Chavez confirms that he is seeking a nuclear accord with Argentina”). El Clarín, 20 October 2005.

³⁶ Poblete, Jason. “Uranium in Latin America”. Notes from Washington D.C., 13 April 2008. <http://jasonpoblete.com/2008/03/13/uranium-in-latin-america-who-is-doing-what/>

³⁷ *Ibid.*

³⁸ Venezuela's uranium reserves and research reactor are probably enough in their own right for it to fall into this category, quite apart from suspicions arising from its contacts with Iran.

killed. The laptop proved to be a veritable mine of information on a wide variety of subjects. Amongst other things, it apparently referred to FARC plans to obtain 110 kg of uranium, and also apparently to a past purchase of about half that amount. Furthermore, at the end of March 2008, an informant led Colombian authorities to a buried stash of around 30 kg of the uranium.

This predictably led to a rash of stories in the international media about FARC plans to build a dirty bomb; or to sell it to other terrorist groups for a similar purpose; or even to use the uranium for armour-piercing ammunition or as an ingestible poison. There were even wilder claims that FARC had paid, or were demanding, \$2.5 million per kilo for the uranium, and that Venezuela had supplied FARC with \$300 million which had been used in this particular deal.

However, the stories quickly fell apart when it became clear that the uranium in question was either natural uranium or at most depleted uranium, which is a by-product of the uranium enrichment process. Moreover, the current market price of natural uranium is only around \$200 per kilo, and less for depleted uranium. Mystery nonetheless still surrounds FARC's possession of the uranium in the first place. On the one hand, it could have been part of some elaborate money-making scheme, with the FARC as either the organisers or victims. But a more worrying scenario is that it could have been part of an international nuclear smuggling ring in which the well-organised FARC was merely one part.³⁹ If such were indeed the case, then uncovering further details, such as the original supplier and end-user, could be crucial. Moreover, it could be that increased regional cooperation under programs such as the Proliferation Security Initiative (PSI) and the Container Security Initiative (CSI) could have added relevance in such situations.

Costa Rica

Almost as a footnote, it is worth mentioning that Costa Rica has a distinguished history in international efforts at nuclear disarmament. Most notably in this regard, Costa Rica was the state which in 1958 began the move within the Organization of American States (OAS) which led eventually to the adoption nearly a decade later of the Treaty of Tlatelolco. Costa Rica also tabled the first draft Model Nuclear Weapons Convention⁴⁰ in the United Nations in 1997. It has been a strong advocate in support of that draft, and is a state sponsor (with Malaysia) of the current updated draft.⁴¹

Treaty Adhesion by Latin American and Caribbean States

NPT

All 33 Latin American and Caribbean States are Party.

³⁹ See comments by Matthew Bunn, senior research associate with Harvard University's Project on Managing the Atom, in "FARC had uranium?" *Passport*, blog by the editors of *Foreign Policy*, 28 March 2008. http://blog.foreignpolicy.com/posts/2008/03/28/farc_had_uranium

⁴⁰ Model Convention on the Prohibition of the Development, Testing, Production, Stockpiling, Transfer, Use and Threat of Use of Nuclear Weapons and on their Elimination UN Doc. A/C.1/52/7 (1997).

⁴¹ <http://www.icanw.org/securing-our-survival>

Treaty of Tlatelolco

All 33 Latin American and Caribbean States are Party.

IAEA

The following are members: Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, El Salvador, Ecuador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru Uruguay, and Venezuela. But the remaining 12 states in the region have yet to become full members.

CTBT

Only Barbados, Cuba, Dominica, St Vincent and the Grenadines, and Trinidad and Tobago have neither signed nor ratified the treaty, while Guatemala has only signed.

***Seabed Treaty*⁴²**

13 Latin American countries are Party (Antigua and Barbuda, Argentina, Bahamas, Brazil, Cuba, Guatemala, Jamaica, Mexico, Nicaragua, Panama, the Dominican Republic, St Kitts and Nevis, and St Vincent and the Grenadines). Six have only signed (Bolivia, Colombia, Costa Rica, Honduras, Paraguay, Uruguay); and fourteen have neither signed nor ratified.

Outer Space Treaty

Eighteen Latin American countries have ratified (Antigua and Barbuda, Argentina, Bahamas, Barbados, Brazil Chile, Cuba, Dominica, Ecuador, El Salvador, Granada, Jamaica, Mexico, Peru, St Vincent and the Grenadines, St Lucia, Uruguay and Venezuela); seven states have only signed; and seven have neither signed nor ratified the treaty.

Antarctic Treaty

Argentina and Chile are considered full members, having signed the treaty from the start. Brazil, Uruguay, Peru and Ecuador are consultative parties, while Colombia, Guatemala and Venezuela are non-consultative parties.

⁴² Treaty on the Prohibition of the Emplacement of Nuclear Weapons and other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and in the Subsoil Thereof which entered into force in 1972.